THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

Consisting of

ORIGINAL COMMUNICATIONS,

SPECIFICATIONS OF PATENT INVENTIONS,

PRACTICAL AND INTERESTING PAPERS,

SELECTED FROM

THE PHILOSOPHICAL TRANSACTIONS AND
SCIENTIFIC JOURNALS OF ALL NATIONS.

MONTHLY INTELLIGENCE

RELATING TO

THE USEFUL ARTS,

PROCEEDINGS OF LEARNED SOCIETIES,

AND

NOTICES OF ALL PATENTS GRANTED FOR INVENTIONS.

VOLUME IV.—SECOND SERIES.

London: 402

PRINTED FOR J. WYATT,
REPERTORY - OFFICE, HATTON - GARDEN.

1804.

Nichols and Son Printers,
Red Lion Passage, Fleet Street.

CONTENTS

OF THE

FOURTH VOLUME, SECOND SERIES.

Specifications of Patents.

Page

Mr. NEWSTEAD'S, for preparing Barilla and Kelp, and the neutral Salts obtained therefrom, — — — — 1
Mr. STUARD'S, for a Method of strengthening Ships, — 6
Mr. CRAANEN'S, for making Verdigris with Ingredients the Produce of Great Britain, — — — 9
Mr. GOULD'S, for an Hydrometer, — — 10
Mr. HUDDART'S, for making great Cables and other Cordage, 81
Mr. DAVIS'S, for a Machine for, and Method of, cleansing and sweeping Chimneys, and extinguishing them when on fire, 90
Mr. KENTISH'S, for an improved Derrick for loading and unloading Ships, — — — — 92
Mr. RANSOME'S, for making and tempering Cast-iron Plough-shares, 97
Mr. HOOPER'S, for Machinery for cleansing Harbours, Rivers, &c. 161
Mr. BEVANS'S, for applying Machinery for striking or sticking Mouldings, — — — — 171
Miss BELL'S, for sweeping Chimneys, and a new Manner of constructing them, — — — 174
Meſſ. ROBERTS and CATHERY'S, for eradicating Smut from Wheat, 181
Meſſ. TREVITHICK and VIVIAN'S, for Improvements on Steam-Engines, and for applying them to driving Carriages, — 241
Mr. EVERETT'S, for Salisbury Angola Mole-Skin, — 249
Mr. HATELY'S, for some reducing Fluxes for purifying Mineral and Metallic Bodies, — — — 250
Mr. BOOND'S, for a new Manufacture of mixed and coloured Cotton Velvets, &c. — — — 252

Page
Meff. SHARP and WHITTEMORE's, for a Machine for making Cards for carding Wool, &c. — — 321
Mr. HAWKINS's, for new Machinery and Methods for Writing, Painting, &c. — — — — 327
Mr. LOOSEMORE's, for manufacturing Cloth, — 340
Earl of DUNDONALD's, for preparing Hemp and Flax, — 344
Mr. WOLLASTON's, for an Improvement in Spectacles, 401
Mr. BENNET's, for a Method of felting Woollen Cloth, 403
Mr. HYMAN's, for a Composition for shaving without Razor, Soap, or Water, — — — 405
Mr. MEDHURST's, for a condensing Wind-Engine, — 406

Original Communications.

Observations on Mr. STUARD's Patent for strengthening Ships. By the Patentee, — — — — 8
On the Means of abolishing the horrid Practice of sweeping Chimneys by Children. Communicated by the Author, — 51
Observations on Mr. KENTISH's Patent for an improved Derrick for loading and unloading Ships, &c. By the Patentee, • 94
Description of an Apparatus for extinguishing Fires in Cotton Factories, &c. to be attached to Steam-Engines or Water-Mills. Communicated by the Author, — — 281
Description of an Improvement on the Siphon. Communicated by Mr. JOHN NORTON, — — — 366
On the Advantages of Mr. BOSWELL's Patent Method of constructing Ships. Communicated by the Inventor, — 430
Description of a self-acting Water-Closet. Communicated by Mr. BENJAMIN HOOKE, — — — 437

Papers selected from the Transactions of Philosophical Societies, &c.

Hints regarding Cattle. By Sir JOHN SINCLAIR, Bart. — 36
Experiments on extreme Branch-grafting of Fruit-Trees. By WILLIAM FAIRMAN, Esq. — — — 98
Method of dyeing Cotton-Yarn a fixed Turkey Red. By M. PIERRE JACQUES PAPILLON, — — 105
Appendix to Sir JOHN SINCLAIR's Essay regarding Cattle, 110
Remarks on the Resistance of Fluids. By Dr. YOUNG, — 121

Account

Page

Account of some Experiments on the Descent of the Sap in Trees. By THOMAS ANDREW KNIGHT, Esq. — — 182

A Chemical Analysis of some Calamines. By J. SMITHSON, Esq. — — — — — 254

On Meteorology as applicable to Husbandry. By Rev. Mr. HOLMES, — — — — 271

On the Preparation, Culture and Use of the Orchis Root. By Dr. PERCIVAL, — — — — 274

Account of a Method of gaining Land from the Sea. By Mr. JOHN KNAPPING, — — — 412

Account of Experiments on feeding Cattle on Potatoes. By JOHN CHRISTIAN CURWEN, Esq. — — — 417

Observations on the Chay Root, a Species of Madder used for dying durable Red Colours in the East Indies. By J. FLEMING, 423

Account of the Method used to recover the Dutch Frigate Ambuscade, sunk near the Great Nore. By Mr. WHIDBEY, — 427

Papers translated from Foreign Works.

On the Employment of Aërostatic Machines in the Military Science, and for the Construction of Geographical Plans. By A. F. LOMET, — — — — — 57

Method of procuring very strong Vinegar at a trifling Expense, 65

Memoir on Vinous Fermentation. By M. THENARD, 67, 130

Improved Method of preparing liquid Ammoniac, — 74

Method of obtaining pure Metallic Cobalt. By M. TROMMSDORFF, — — — — 126

Extract from a Memoir on the febrifuge Principle of Quinquina. By M. SEGUIN, — — — — 127

Improved Method of preparing Mineral Kermes, — 140

Method of manufacturing Earthen-Ware capable of resisting sudden Transitions from Heat to Cold. By M. FOURMY, 141. 211

Memoir on the refining of Lead, and a new economical Method of constructing Cupels. By M. DUHAMEL, — 194

Description of a portable Thermometer, to ascertain the Temperature of Vats, Coppers, &c. and for other Uses, — 228

On the Art of hardening Copper, — — 231

Method of converting into Ether almost the Whole of any Quantity of Alkohol. By M. VAN MONS, — — 283

Page.

Method of producing Fruit from Trees inclined to run to Wood, and of increasing the Strength of Timber-Trees. By A. G. M. SURIRAY DELARUE, — — — — 285

Process for extracting Soda from Minerals. By M. KLAPROTH, 295

Notice on several Processes for gilding and silvering Metals, 298

Notice on the Dutch Method of salting Herrings, — 305

On the double Refraction of Rock-Crystal. By P. TORELLI DI NARCI, — — — — 367

Method of constructing Chimneys to prevent them from smoking. By M. PIAULT, — — — — 371

Description of Woulf's Apparatus with moveable conducting Tubes. By M. SCHMIDT, — — — 373

Extract from an Essay on the Preparation of Prussiate of Potash perfectly free from Iron; by J. RICHTER. With Experiments on Combinations of Prussic Acid with salifiable Bases; by J. B. VAN MONS, — — — — 374

Observations on the Imperfection of Furnaces for Evaporation, and on a new Method of constructing them. By M. CURAUDAU, 383

On the Preparation of pure Gallic Acid. By J. B RICHTER, 388

Process for extracting the Salt with a calcareous Basis contained in yellow Quinquina. By M. DESCHAMPS, — 391

New Process for preparing the Muriates of Barytes and of Strontian. By M. BOUILLON LA GRANGE, — — 439

On the Preparation of a Blue Colour from Cobalt, as fine as Ultramarine. By M. THENARD, — — — 449

Simple and constant Process for obtaining the Colour known by the Name of Turkey or Adrianople Red, in its greatest Beauty and Solidity. By M. HAUSSMANN, — — 452

Account of the Bridge which is constructing at Paris between the Louvre and the Hotel de Quatre Nations, and of the Experiments made to ascertain its Stability, — — 456

Account of an improved Machine for stamping Ores. By M. DUHAMEL, — — — — 458

Monthly Intelligence relating to Arts, Manufactures, &c.

Composition for covering the Stems of Trees, — 76

Threshing Mill—Parsnips—Hemp — — — 77

Manures—Lord MULGRAVE's Premiums — — 78

Preventive

	Page
Preventive of the Plague—Method of giving to Malt Spirit the Flavour of Brandy, — — —	79
Wool of New South Wales, — — —	80
Action for Damages for taking an undue Advantage of the Communication of an Invention, and obtaining the King's Patent, to the Prejudice of the Inventor, — —	150
Action for Infringement of a Patent, — —	156
Smithfield Club—New Thermometer, — —	158
Society for improving the Condition of Chimney Sweepers,	159
Bath and West of England Society of Arts, &c. —	159
Highland and Agricultural Society of Scotland, —	236
Description of a Mechanical Pulley, — —	238
Depth of Rain fallen at Liverpool, — —	239
Observations on improved Machinery in the Woollen Manufacture, — — — — —	307
Improvement in the Manufacture of Hemp and Flax, —	311
Advantages of deep ploughing for Potatoes, — —	312
Potatoes recommended for feeding Sheep, — —	315
Machine for measuring the Rapidity of Bodies discharged by Artillery, — — — — —	316
Account of Food consumed by Mr. Whittle's Prize-Hog,	317
Contrivance for warming Carriages, — —	318
New Earth called Augustine—Machine for shearing Cloth,	319
Society of Sciences of Bordeaux—Society of Agriculture of Paris,	396
New Thrashing Mill—Engraving on Stones, —	397
Method of preserving Turnips from the Fly, — —	398
Experiments on Wool—Method of preserving Pulse from Weevils,	399
The Cow-Pox a Preventive of the Rot in Sheep, —	461
Use of Garlic against Moles—New Preparation of Vinegar,	462
New Substitute for Coffee — Discovery of a new Species of Wheat, — — — —	463
Method of purifying corrupted Water, — —	464
Patents granted for Inventions in the Months of October, November, December, January, February and March,	80. 160. 240. 320. 400. 464

PLATES.

PLATES

IN THE

FOURTH VOLUME, SECOND SERIES.

		Page
1.	Method of strengthening Ships, — —	8
2.	Instrument to ascertain the Wear of Gold, —	34
3.	Section of a Stack of Chimneys, — —	56
4.	Machine for making Cordage, — —	88
5.	Improved Derrick, — — —	96
6.	Illustration of Mr. FAIRMAN's Method of extreme Branch-grafting; and of Dr. YOUNG's Remarks on the Resistance of Fluids, — — — —	104
7.	Machinery for cleansing Harbours, &c. — —	170
8.	Machinery for striking or sticking Mouldings, —	174
9, 10, 11.	Improvements on the Steam-Engine, —	248
12.	Machinery for Drawing, &c. — — —	340
13	Improved Gun-Lock, — — —	346
14.	Improved Siphon; Contrivance to prevent Chimneys from smoking; Improvement on Woulf's Apparatus; and Evaporating Furnace, — — —	388
15.	Condensing Wind-Engine, — — —	412
16.	Improvement on Spectacles; Self-acting Water-Closet; and Machine for stamping Ores, — — —	438
17.	Cast-Iron Bridge, — — — —	462

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XIX. SECOND SERIES. Dec. 1, 1803.

Specification of the Patent granted to THOMAS NEWSTEAD, *of Kingston-upon-Hull, in the County of York, Chemist; for a Method of preparing Barilla and Kelp, and the neutral Salts obtained therefrom.*

Dated June 18, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Newstead do hereby declare, that my said invention is described in manner following; that is to say:

How Barilla and Kelp is to be prepared for Soap-making, Bleaching, and Alum-making.

First. I prepare barilla and kelp to obtain the alkali they contain in a concentrated state by lixiviation, and separating the neutral salts from the alkali.

Second. I decompose the sulphate of potash and sulphate of soda (neutral salts) separated from barilla and kelp.

Third. I prepare the muriate of potash, which I separate from barilla and kelp, for the use of the alum-manufacturer.

Fourth. I separate the neutral salts contained in soap-makers spent lie, their salts prepared from spent lie, and the black ash prepared from their salts or spent lie.

Fifth. I decompose the sulphate of potash and sulphate of soda contained in the soap-makers spent lie, and their salts prepared from their spent lie, and the black ash prepared from their salts or spent lie.

Sixth. How I apply the alkalies and neutral salts to soap-making, bleaching, and alum-making.

1. To concentrate the alkali contained in barilla and kelp, I grind it very small, then saturate any quantity of water my pan will conveniently boil (which is a flat-bottomed cast-iron pan). I add barilla or kelp, by a small quantity at a time, till the boiling water is quite saturated. I then turn the liquor over into a vat, provided with sand to filter. I add about half as much water to the remains in the pan as I had at first, and allow it to boil, and then turn it into the vat to filter. I then fill up the pan with fresh water, and boil the remaining barilla or kelp for a short time; then draw or damp the fire, to allow the residue of the barilla or kelp to fall to the bottom of the pan, which I take out with a proper draining-shovel, and consider it worth nothing more than for manure, or for the use of the glass-manufacturer. I then saturate this water or weak lie with fresh barilla or kelp, and go on as above.

Next I take the filtered liquor, and fill up a flat-bottomed iron or lead pan, and boil till a strong pellicle is formed; this is to be tasted, to know what neutral salt it is; it is mostly sulphate of potash, but is easily known by being very insoluble in the mouth, and feeling like sand

sand between the teeth. When sulphate of potash appears first, which I know from the pellicle, I boil slow, and take out the salt as it falls to the bottom of the pan, frequently tasting the pellicle, to discover when it is formed of muriate of potash, which is the next salt to appear, (as barilla or kelp is never found free of it,) and is known by its strong salt and disagreeable bitter taste. As soon as I find the pellicle formed of muriate of potash, I draw the fire, and allow the liquor to be still for about ten minutes. I then take a draining-shovel, and take out all the salt that has fallen to the bottom of the pan, which will be sulphate of potash. After this is done, I turn the remaining liquor into a cooler, and let it stand till quite cold. I then return it into the pan, to be boiled again till a pellicle is formed, and then to be returned into the cooler, having first taken out of the cooler all the crystals of muriate of potash formed in the last cooling. They must be put into a box or basket to drain dry, and then are in a proper state to be used by the alum-manufacturer. Boiling and cooling is to be repeated till no more muriate of potash is obtained. The remaining is dried down, and consists of carbonate of soda, some sulphate of soda, and a little muriate of soda.

2. To decompose sulphate of potash, I take its weight of carbonaceous matter, such as charcoal, smallcoal, cokes, saw-dust, or tanners' waste bark, and one-third its weight of carbonate of lime (chalk ground), or lime that has been some time slaked. These are well mixed together, and put into a reverberating furnace, and frequently stirred till all the carbonaceous matters be consumed, and the whole be in compleat fusion before drawn out. After which it may be concentrated as in article the first, only there will be some undecomposed sulphate and sulphite of potash, as the only neutral salts which

 will

will be precipitated by boiling; as directed for separating the sulphate of potash. The remaining liquor to be dried down, and will consist of carbonate of potash.

Sulphate of soda is to be decomposed by the same method as sulphate of potash. After which it is to be lixiviated, filtered, and boiled, till a pellicle is formed, and then put into a cool dry place, and in a few days crystals of soda will be formed. The liquor must be drawn from them, and returned to be boiled, and again cooled; this is to be repeated till no more crystals of soda is produced. The remaining liquors will consist of sulphate of soda and sulphite of soda, to be dried down, and again put into the furnace with carbonaceous matters.

3. Sometimes muriate of potash will be found in the cooler uncrystallized, in that case it is to be dissolved in water to a crystallizing pitch, and turned into a cooler, and crystals of muriate of potash will be obtained. This is the best preparation of it for the alum-manufacturer.

4. To separate the natural salts contained in soap-makers spent lees, it it to be filtered, to deprive it of as many impurities as possible. Then a pan is to be filled up, and the liquor to be boiled, as in article the first, to take away the sulphate of potash. Then the liquor is to be cooled, and boiled till no more muriate of potash is obtained, as in the first article. The liquor will then consist of sulphate of soda and a little muriate of soda, to be dried down and decomposed, as also the sulphate of potash first separated.

To separate the neutral salts contained in salt prepared from soap-makers spent lee, I first make it into black ash, by running it through a fusing-furnace; I therefore treat it as black ash, and in separating the neutral salts contained in black ash prepared from soap-makers spent lee, I grind it small, dissolve it, and filter it;

it; then separate the salts, as I do in the soap-makers spent lie above.

5. To decompose the sulphate of potash and sulphate of soda contained in soap-makers spent lie, salts prepared from their spent lie and black ash prepared from their spent lie or salts.

The sulphate of potash and sulphate of soda to be decomposed and concentrated as in article first and second.

6. In applying the concentrated alkalies to soap-making, nothing more is wanting than to causticise them with half their weight of quick-lime, and use the lie at a strength that it will easily unite with tallow. Any sulphate of soda or muriate of soda not separated is found useful in the operation of soap-making in small quantities.

In applying the concentrated alkalies to bleaching, they are to be causticised (when wanted to be used as pot-ash) with half their weight of quick-lime, and a lie made, which is to be boiled down to a dry salt, and kept close for use. When wanted to be used as pearl or comby ashes, nothing more is to be done to them than to put them into a reverberating furnace, and keep stirring them well till they come nearly to fusion, then taken out and used.

The muriate of potash crystallized is the most advantageous way of using it in the making of alum, and no salt produces more alum than it, except carbonate of potash when pure. The muriate of potash is to be used in the process of alum-making as carbonate of potash.

In witness whereof, &c.

Specification

Specification of the Patent granted to James Stuard, *of London-street, in the Parish of St. Dunstan, Stepney, in the County of Middlesex; for a Method to strengthen Ships or floating Vessels in such a Manner as may often prove the Preservation of Life and Property.*

Dated July 27, 1803.

With a Plate.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said James Stuard do hereby declare, that my said invention is described in the drawing hereunto annexed, (see Plate I.) and the following description thereof; that is to say: The use of my invention is to preserve life and property, by making a ship much stronger than on the common construction; so that should she, by stress of weather, be drove on shore, she will keep upright, and be better able to resist the threatening danger. I lay a keel on each side the middle line, distant from it, including the thickness thereof, one-sixth of the average breadth at loading draft of water, or a little more or less, according to the fullness or sharpness of the ship. Which keels may be bolted through the floor timbers or futtocks, or both, and through keelsons on the inside; to have no keel on the middle line, except for a short length, to connect with stem and stern-post where the side keels end. The keels are marked A A, B B, C C, Fig. 1. The short keels to be bolted through the dead-wood and keelson D D; and the intermediate part of that keelson through the floor timbers, and through a piece of thick stuff, which butts between the short keels. The position

of

of the keels as they bear on the ground are shewn at Fig. 2: or if the ship is either of very large dimensions, or exceedingly sharp, the plan Fig. 3 may be most suitable. The distance of the side keels, from out to out, is found by dividing the half breadth draft, Fig. 4, into eight equal parts on the middle line, and take the measure therefrom to the load draft of water line on the seven lines. Add them together, and divide by seven, gives the average half breadth; one-third of which is the distance required; which, being put on the timbers Fig. 5, gives the different depths; which put on B B, Fig. 1, and drawing a fair line, gives the curve of the upper side of the side keels; which keels not only prevent the ship from straining, by keeping her upright when on shore, but strengthen her at all times, make a good foundation for a double row of pillars under the beams, and are advantageous to her sailing, as is evident by Fig. 6, where heeling to an angle of twenty degrees, the lee-keel is one foot six inches deeper in the water than if it was on the middle line, consequently must make her more weather-ley, which may enable her to clear a lee-shore. Ships on this construction may be built without shoring up, and launched without having bilge pieces fitted on their bottom, whereby the coppering may be completed on the stocks. Every beam may be strengthened, and the hull kept from racking or being over strained with carrying sail, by having diagonal carlings between the beams as Fig. 7, which though drawn for an upper deck is equally serviceable for any deck, or the decks may be laid as Fig. 8: those parts where the beams are not covered to be laid fore and aft. Also, instead of working the cieling plank in the common way, if they are done as Fig. 9, the weight of both ends is thrown on the middle, which must tend to prevent hoging. Fig. 9, by being

ing bent at two or three strakes from the keelson will shew one side and half the bottom.

The bottom of barges, or any other vessels, may be strengthened by diagonal pieces, as represented at Fig. 10, which pieces may be either short, to go between the floor timbers, or long, and scored out about half their thickness, to let them down between the floor timbers; also the sides may be strengthened in the same manner, see Fig. 11. Boats with keels on this construction are better adapted for loading on a beech, carrying a large gun, or landing troops; are easily hauled up or launched, and have the same advantage in sailing as ships. The ends of all diagonal pieces to be let in with an abutment, as Fig. 12. Thus have I, either by words or drawn figures, specified my invention; but the form of vessels being so various, it is impossible every particular can be so described as to suit all; but, from the above, and the drawings annexed, any person of ordinary capacity cannot fail to make a proper application.

In witness whereof, &c.

Observations by the Patentee.

A ship thus secured from straining is more likely not to work her plank loose, which often occasions foundering; and if by stress of weather she is unavoidably drove on shore, she has greatly the advantage of ships on the common construction, as they, laying on an edge, easily roll by the agitation of the sea, and strike against the ground, and, when left by the tide, are often bulged by the overhanging weight; but ships on this construction having one-third of their breadth to stand on, will neither roll nor be likely to bulge; and if, from the declivity of

of the ground, another ship would overset, this will not, having two-thirds of the weight to counteract it. Therefore, as the preservation of lives and property at sea are of great importance to the community, the above construction of ships are recommended to all whom it may concern. They may be built by any ship-builder in England, &c. by paying unto the patentees a small compensation *per* ton, and shall be furnished with drafts, by applying to St. Barbe and Stuard, No. 6, Cock-hill, Ratcliff.

Specification of the Patent granted to DANIEL CRAANEN, *of Cullum-street, Fenchurch-street, in the City of London, Merchant; for making Verdigris in Lumps or Powder, with Ingredients the Produce of Great Britain.*

Dated November 19, 1802.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Daniel Craanen do hereby declare, that my said invention is described in manner following; that is to say: Upon any given quantity take one part of the very best sal-ammoniac, one quarter part of oil of vitriol, one half part of aquafortis, one quarter part of acid muriatic, and twelve parts of cold spring-water, which, when thoroughly mixed together, is put into sheets of copper, of any size, turned up at the edges about half an inch all the way round, to prevent the mixture from running off. The mixture is then stirred well up every two or three hours, until the same is discovered to be of a green or bluish cast or body. The mixture must then remain a few hours, until it is settled, and the

water at top appears perfectly clear, which will happen sooner or later, it depending upon the temperature of the atmosphere. The water must be then carefully poured off, leaving the sediment at the bottom. It must be then put into any vessel of sufficient size, and if it is thoroughly prepared the paint will bear a washing, to free it from dirt, &c. without mixing with the water; after which washing, the water must be poured from the paint. The paint may then be taken and prepared in lumps by putting the same into moulds of any size that may be convenient, observing afterwards to place the same in a mild warm room. When it is quite dry, it may be ground into powder with ease, or remain in the lumps, as may be convenient; it is then fit for use.

In witness whereof, &c.

Specification of the Patent granted to CHESTER GOULD, *of Red Lion-street, Clerkenwell, in the County of Middlesex, Gentleman; for an Hydrometer on a new Principle, for the Purpose of ascertaining the Strength of Spirits, and determining the specific Gravity of Fluids in general.* Dated September 3, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Chester Gould do hereby declare, that my said invention is described as follows; that is to say: I procure two glass tubes or cylinders, with a bore or calibre, about the size of a goose quill, and thirty inches long. These two tubes I enclose in a brass tube, of such diameter as will receive them with convenience, in order that they may be secure from injury or accident. On one

one end of these tubes I fit a small cyringe or pump, in such manner as to exhaust the air from both of the glass tubes at the same time with the same cyringe or pump. Then the instrument becomes a double pump, or a pump with two parallel tubes, which are both exhausted by one piston. If water is drawn into both tubes it will rise to an equal height by the weight of atmosphere; but if a column of water is drawn into one tube, and a column of the highest rectified spirit into the other, the two columns will rise to different heights. The different length of these columns will be in exact proportion to their gravity; and this difference will determine the length of a scale which I graduate by actual experiment, by diluting the spirit one *per cent.* at a time, and repeating the experiment till the scale is finished. When it is finished it is fitted to the glass tubes near the cyringe, so as to apply like the scale of an hydrometer. On the other end of the instrument, a small vessel is fitted to receive the liquors. This vessel is separated into two equal parts by a partition, so that one part may be filled with water and the other with spirits, and both remain separate. This partition passes between the two glass tubes. When a sample of spirits is to be tried, one side of this vessel must be filled with water, and the other with the sample to be tried. Then it is drawn into the instrument till the water rises exactly to the bottom of the scale, and the spirits will then rise higher to the proof-mark, or above or below, according to its strength. If a sample of spirits is tried in this instrument by another sample of known proof, the difference will appear on the scale without the assistance of the thermometer, because the state of the atmosphere affects both samples alike, or very nearly so. The size and proportions of this instrument may be varied at pleasure. Some of them are provided with a stop-

cock, for the purpose of more conveniently retaining the fluids in the instrument till the observation is made. This cock is fitted between the syringe and the end of the glass tubes; and others are made with a cock instead of a syringe; and then the instrument is exhausted by the mouth, and the cock is turned to retain the liquor in the instrument till the observation is made.

In witness whereof, &c.

Experiments and Observations on the various Alloys, on the Specific Gravity, and on the comparative Wear of Gold. Being the Substance of a Report made to the Right Honourable the Lords of the Committee of Privy Council, appointed to take into Consideration the State of the Coins of this Kingdom, and the present Establishment and Construction of His Majesty's Mint.

By CHARLES HATCHETT, *Esq. F.R.S.*

With a Plate.

Abstracted from the TRANSACTIONS of the ROYAL SOCIETY. By Mr. DAVY, of the ROYAL INSTITUTION.

THIS abstract contains the result of a great number of accurate and laborious investigations on the properties of the alloys of gold. They were made at the request of the Lords of the Committee of his Majesty's most honourable Privy Council, appointed by his Majesty on the tenth of February, 1798, to take into consideration the state of the coins of the kingdom.

Mr. Hatchett was assisted in his researches by the valuable advice of Henry Cavendish, Esq. F, R. S. and the machines

machines for ascertaining the wear of the coins were invented by that gentleman.

The full detail of the experiments, which occupied between two and three years labour, are inserted in the Philosophical Transactions for 1803.

The principal object of the experiments was to ascertain, whether the great loss which our gold coin appears to have sustained within certain periods had really been caused, or had been materially influenced, by any important defect, either in the quality of the standard gold, or in the figure or impression of the coin; but, in order to determine this, the decision of two questions became necessary; namely,

First. Whether very ductile gold, or gold as hard as is compatible with the process of coining, suffers the greatest loss, under the general circumstances of friction?

Secondly. Whether coins with flat, smooth, and broad surfaces, wear less or more, than coins which have certain protuberant parts raised above the ground or general level of the pieces?

It appeared, that neither of these questions had ever been decided by actual experiment, and the best informed persons were in every respect much divided in their sentiments; for some conceived hard, and others soft gold, to be the best for coin; and some in like manner believed, contrary to the general opinion, that the pieces which were flat and smooth were more susceptible of wear than those which had fewer points of contact in consequence of protuberances. As therefore nothing certain relative to these matters could be gained from books, nor from those who were consulted, the solution of the questions was attempted by the experiments which will now be described; and for this purpose

pose, the Lords of the Committee furnished the requisite means.

The wear or abrasion of coin is a mechanical effect, subject to be modified by certain physical properties, such as ductility and hardness; and as these last-mentioned properties in mixed or alloyed metals are much influenced by chemical effects, which the different metals mutually produce upon each other, it naturally follows, that the experiments required to investigate the present subject must form three distinct series, in the first of which will be comprehended the chemical experiments, or those which relate to the effects produced upon gold by the addition of different metals in certain given and equal relative proportions.

The second series will include the experiments which relate to the different degrees of density observed in gold when variously alloyed; and, as the specific gravity of standard and other gold has always been regarded as one of the most certain tests of its quality, exclusive of chemical analysis, it appears to be of much importance to ascertain how far this can with certainty be depended upon; and how far, and from what causes, it is liable to unavoidable and occasional variations.

The third and last series consists of those experiments which may be called mechanical, and which were expressly intended to ascertain the comparative wear of different kinds of gold, by various modes of friction.

The account of the whole of these experiments has therefore been digested into three separate parts, corresponding to the three principal series which have been mentioned.

SECTION

SECTION I.

A. From the various experiments made with arsenic and gold, in open and close vessels, it appears, that arsenic combines with gold only under certain circumstances; but when united with it, then the colour and ductility of gold become considerably affected, and the arsenic (although naturally volatile) cannot easily be completely separated, even by long-continued fusion.

B. Antimony more readily combines with gold, under all general circumstances; and it is proved, by the experiments, that ¼ of a grain of antimony in the ounce Troy, or the $\frac{1}{1920}$ part of the mass, is sufficient to destroy the ductility of gold.

C. Zinc, whether alone, or mixed with copper in the state of brass, also destroys the ductility of gold; but it is easily separated by heat.

D. Cobalt affects the colour and malleability of gold, until the proportion is reduced to four grains *per* ounce; the effects of it then begin to cease.

E. Nickel is not so injurious to gold as the foregoing metals, as four grains did not produce any remarkable effect; and there is reason to believe, that of all those which are improperly called semimetals, nickel is that which is the least prejudicial to gold.

F. Manganese changes the colour, and considerably injures the ductility of gold.

G. Bismuth is highly destructive of the general properties of gold; for the vapour of it affects that metal even when melted in open vessels. Like antimony, a very small proportion of bismuth, such as $\frac{1}{1920}$ part, is sufficient to render gold completely brittle.

H. The effects of lead upon gold resemble those of bismuth in every particular.

I. Tin

I. Tin is by no means so destructive of the ductility of gold as is commonly believed; for it may be combined in the proportion of eight grains *per* ounce without producing any bad effect. A larger quantity undoubtedly renders gold brittle; but, upon the whole, the effects of tin have been much exaggerated.

K. The effects of iron upon gold have been, if possible, more universally misrepresented and misunderstood than even those of tin; for, contrary to the general assertion and belief, that iron is extremely injurious to the ductility of gold, it is proved, by the present experiments, that gold may be alloyed with the full standard proportion of wrought-iron, cast-iron, and even cast-steel, without being thereby made brittle; and, although a certain degree of hardness is thus produced, yet the metal remains perfectly ductile. The most remarkable effect produced by iron upon gold, is the great alteration of its colour; for by $\frac{1}{12}$ of iron, gold becomes almost white.

L. Many eminent metallurgists have asserted, that emery powerfully acts upon gold, and renders it brittle; but the present experiments prove, that this is a very erroneous idea, as it is impossible to combine emery with gold.

M. Gold when alloyed with $\frac{1}{12}$ of platina remains extremely ductile, but the colour becomes like that of tarnished silver. When gold was alloyed with $\frac{1}{12}$ platina and $\frac{1}{12}$ of copper, it became of a dull yellow, and was not quite so ductile as when platina alone was employed. It may here be observed, that the remarkable change of colour produced by small quantities of platina upon gold, and the peculiar chemical properties of the former metal, render it so easy to be detected, that there does not ap-

pear

bear any reason to apprehend the employ of it in the adulteration of the gold coin.

x. Copper when pure, and in the proportion of $\frac{1}{12}$, is well known as the metal which is most commonly employed to alloy gold.

The gold thus alloyed is very ductile, and of a deep colour; but when the copper is not pure, then the ductility of gold becomes more or less affected.

There are several kinds of copper known in commerce which are found to be nearly or quite equally proper for general purposes; but when an alloy for gold is required the case is very different; then it appears, that none can so much be depended upon as the fine granulated Swedish copper: for the others, such as the varieties of British copper, and the Swedish copper dollars, which are employed in our mint as an alloy for silver, are found commonly, or at least very frequently, to render the gold brittle, although, in every other respect, they appear to possess all the obvious and general properties of what may be called good and pure copper.

Some of the experiments which have been made for the purpose of the present investigation, prove that antimony or lead may be combined with copper in a much greater portion than what is required to destroy the ductility of gold, while the copper itself suffers no apparent change in colour, ductility, nor in any other characteristic of pure and good copper; so that the presence of antimony or of lead would not be suspected, but by the effects produced upon gold by copper thus adulterated; and as the ores of lead and of antimony so frequently accompany those of copper, as the last portions of these metals are with difficulty separated from copper during the process of smelting, and as instances have even been known of copper adulterated with a large proportion of these metals

tals having been purchased for the use of certain foreign mints, and that the adulteration of the copper was only first discovered by the effects which it produced upon the precious metal, there is every reason to suspect the presence of antimony or of lead in those kinds of copper which in our mint are so frequently found to be injurious, and this suspicion has since been confirmed by various analyses purposely made. It is therefore proper that a previous trial of the copper, intended to be purchased for the use of mints, should always be made upon a small quantity of gold.

The experiments also present another curious fact, which is, that gold, when alloyed with any copper which has a tendency to make it brittle, has this property much increased by being cast in moulds of sand; and, on the contrary, that moulds of iron counteract and diminish the brittle quality of such gold; so that, unless the original degree of brittleness be very considerable, the same gold may be made alternately ductile, or brittle, merely by changing the moulds. But if the copper is pure, then the ductile quality of the alloyed mass always continues the same, whether the metal is cast in iron or in sand.

As copper therefore, when pure, is always uniform in its effects upon gold, and, when employed in standard proportion, forms a metal possessed of considerable ductility, it may be considered to be liable only to one objection; namely, the deep colour which it communicates to gold: but this is too much a matter of fancy to merit attention.

o. Gold alloyed with $\frac{1}{12}$ of pure silver is the most ductile of any of the varieties of standard gold; but it is of a very pale yellow colour; in other respects it does not present any remarkable property.

From

From this concise statement of the results of the experiments contained in this part, it must be evident that, agreeably to general practice and opinion, only two of the metals are proper to be employed to reduce fine gold to standard, *viz.* silver and copper, for all of the others either considerably alter the colour, or diminish or destroy the ductility of gold.

Silver and copper therefore, either separately or conjointly, must be regarded as the only proper alloys for gold coin; but the truth of this assertion, as well as the comparative advantages attending the employ of each of these metals, will be more fully ascertained by the results of those experiments which will be noticed in the subsequent parts of this Report.

SECTION II.

A. In the second part, as has been stated, an account is given of those experiments which relate to the specific gravity of gold made standard by different metals, single or mixed.

This subject does not appear to have been hitherto so fully investigated as it really merits, for the present experiments prove, that many, and even considerable, alterations are produced in the specific gravity of metallic substances by various causes, several of which seem to have escaped the notice of men of science; and there is much reason to believe that the test of specific gravity is by no means so unexceptionable and so decisive as has generally been imagined.

B. The defects of the instruments, and the difficulties which attend the operations, employed in experiments of this nature, being for the greater part well known, they were consequently obviated and counteracted, as much as possible, when the experiments were made.

Supposing, however, that these experiments are performed with the most delicate instruments, and with all possible care and attention, yet, when metals are to be examined, various circumstances require to be taken into consideration.

The most important of these are, as would appear from the detail of facts,

First, imperfections in the interior of the mass, which are produced during the processes of melting and casting.

Secondly, the difference of density in parts of the same mass, resulting from the quantity and quality of the metal, from the nature of the mould, from the more or less vertical position of it, and from the height of the column or bar of metal.

Thirdly, the unequal mixture of the metal or metals throughout the mass intended to be alloyed.

Fourthly, the peculiar effects which certain metals produce, when employed singly or conjointly as alloys, and which are very different from the results of calculation.

And, fifthly, heat, whether produced by friction or excited in any other manner.

As therefore the specific gravity of metals is liable to be influenced by such different causes, it is almost in vain to expect absolute precision in the results of such experiments; and although, by proper care and attention, a degree of accuracy may be attained sufficient for almost every useful purpose, yet, from what has been said, it must appear evidently absurd to form opinions upon small fractional variations.

From the experiments which Mr. Hatchett made, with every possible precaution, upon separate and entire ingots of gold reduced to standard by silver, by silver and copper,

copper, and singly by copper, it was proved, that the specific gravity of each of these kinds of standard gold was as follows.

Gold made standard by silver	17.927
Gold made standard by equal parts of silver and copper	17.344
Gold made standard by copper	17.157

Now as our gold coin frequently, and indeed commonly, contains silver as part of the alloy, and as at different times this proportion of silver must have been various and even considerable, particularly when the gold of Portugal (which is alloyed with silver) was employed, it naturally follows that, exclusive of the many other causes of variation which have lately been enumerated, the specific gravity of our standard gold must occasionally be different, according to the relative proportions of silver and copper which compose the alloy; and as the specific gravity of gold made standard by silver is 17.927, while that of gold made standard by copper is only 17.157, so, according to the relative proportions of these two metals when united in the alloy, the specific gravity of standard gold may vary between the two extremes of 17.927 and 17.157; or indeed, when some allowance is also made for small variations arising from other causes, the whole range of the different specific gravities of gold made standard by silver and copper may be considered as extending from 18 to 17.

SECTION III.

The third and last part contains the account of the result of the experiments intended to ascertain the comparative wear of gold when variously alloyed.

A. As

A. As the preceding experiments had fully proved that silver and copper are the only metals proper to be employed as alloys for gold, it appeared superfluous to subject to friction all the other varieties of standard gold which have been formerly mentioned.

The experiments now under consideration were therefore principally confined to fine gold, and to gold made standard by silver, by silver and copper, and by the different kinds of copper known in commerce; these consequently produced considerable varieties in the degrees of comparative ductility and hardness; but, in order more completely to investigate the subject, some experiments were also made upon gold much debased by copper, as well as upon pieces of standard silver, and upon others of pure copper.

B. The whole of the experiments which compose this third part may be divided into three subordinate series, the two first of which were directed to the consideration of that part of the diminution of the coin which arises from the rubbing of one piece of metal against another.

The third series was intended to show the comparative power of gold, differently alloyed, to resist abrasion from sand, or other gritty powders.

The general results of these extremities are;

First, that when equal friction, assisted by a moderate pressure, takes place between pieces of coin which are of a similar quality, then abrasion is most commonly produced in an inverse ratio to the degree of ductility.

Secondly, that the contrary effect happens when pieces of different qualities rub against each other; for then the more ductile metal is worn by that which is harder.

And, thirdly, that earthy powders and metallic filings produce similar effects, and tend to wear the different

kinds

kinds of gold in proportion to their respective degrees of ductility.

D. Fine gold, being extremely soft and ductile, sustains a considerable loss under many of the general circumstances of friction; and, as at all times it appears certain, that the impressions which have been stamped upon it are most easily obliterated, even when actual abrasion does not take place, there is much reason to conclude, that gold of such extreme ductility is not that which is the most proper to be formed into coin.

E. But gold of the opposite quality, or at least so hard as to be but just capable of being rolled and stamped, seems to be equally improper for that purpose; for even supposing that hard or brittle gold suffered in every case less by friction than that which is moderately ductile, (which is not however the fact,) and allowing that standard gold may by a mixed alloy be rendered as hard as gold reduced by copper to 18 carats, without changing the standard proportion of gold, yet it would be very difficult always to make such standard gold of an uniform degree of hardness. Moreover, by some experiments purposely made by Mr. Hatchett at the mint, upon the rolling and stamping of gold of different qualities, it evidently appeared, that gold, equal in hardness to that of 18 carats, could not be employed with advantage; for the additional labour which was required for the rolling and stamping of this hard gold, the frequent failure in making the impression, and the bruising and breaking of the dies, fully proved, that the expense and difficulty attending the working of such gold could by no means be compensated by the small degree of durability which it might possess over any other.

F. The extremes of ductility and of hardness being therefore equally objectionable, it follows of course, that gold

gold of moderate ductility must be that which is the best adapted for coin; and, as nothing but silver or copper can be employed to alloy gold which is intended to be coined, it may be here observed, that, whatever might have been the original motive for introducing the present standard of 22 carats, yet it appears, from the experiments, that this standard proportion of $\frac{1}{12}$ of silver or copper is (every circumstance being considered) the best which could have been chosen.

There is however some difference in the quality of gold when alloyed with the standard proportion of silver, of silver and copper, and of copper, which requires to be considered.

o. Gold alloyed with one-twelfth of silver is of a fine but pale yellow, it is very ductile, it is easily rolled, and may be stamped without being annealed; it consequently does not require to be blanched; and, after the complete process of coining, the surface and every part remains of an uniform quality, so that by wear it does not appear of different colours.

These properties are certainly much to be valued, but the objections to this kind of standard gold are,

First, the additional expense attending the employ of silver as an alloy.

Secondly, the extreme pale yellow colour.

And, thirdly, that, from its great ductility, it is almost as liable to have the impressions which have been made upon it speedily obliterated as those which have been made upon fine gold. All things being therefore considered, gold alloyed only with silver does not appear to be so proper for coin as may at first be imagined.

n. Gold, made standard by a mixture of equal parts of silver and copper, is not so soft as gold alloyed only with silver,

silver, neither is it so pale, for it appears to be less removed from the colour of fine gold than either the former or the following metal. Gold alloyed with silver and copper, when annealed, does not become black, but brown; and this is more easily removed by the blanching liquor or solution of allum than when the whole of the alloy consists of copper. It may also be rolled and stamped with great facility; and, under many circumstances, it appears to suffer less by friction than gold alloyed singly by silver or by copper.

After it has been, however, subjected to the ordinary friction, which must take place during the circulation of money, it is liable to appear of a deeper colour in those parts which, being prominent, are consequently the most exposed to friction; this defect arises from a cause which will soon be explained, but it cannot be regarded as an objection of any weight.

1. The last kind of standard gold which remains to be mentioned, is that which is alloyed only by copper. This is of a much deeper colour than those which have been hitherto noticed, and is slightly harder than either of them, but nevertheless it is very ductile, provided that the copper be pure. It requires to be annealed, and then becomes nearly or quite black; which colour is not so easily removed by the blanching liquor as that which is produced by the process of annealing upon gold alloyed with a mixture of silver and copper.

Gold made standard by copper suffers less, by many of the varieties of friction, than gold which is alloyed with silver; but in some cases it seems to wear rather more than gold alloyed with silver and copper; the difference is not however very considerable.

This sort of standard gold, as well as that which is alloyed with silver and copper, appears commonly, after a

 certain

certain degree of wear, more or less of a deep copper colour in those parts which are most prominent; and when coin thus alloyed exhibits such an appearance, it is frequently and vulgarly said to have been in contact with copper money; and sometimes guineas, having this appearance, have been refused, upon the supposition that they have been debased; but the real fact is, that when copper constitutes part or the whole of the alloy, it becomes oxidized or calcined upon the surface of the blanks, by the process of annealing, and the blackish crust of copper, in this state, must then be removed by the solution of alum, called the blanching liquor; now it is evident, that after this operation, the surfaces of the blanks or unstamped pieces can no longer be regarded as standard gold; for if copper singly forms the alloy, it must be dissolved, and be separated from the surface of each piece of coin; and the same effect must also take place with respect to the copper in the alloy formed of copper and silver; so that, in the first case, each piece, when blanched, will consist of gold made standard by copper, covered with a thin coat of fine gold; and, in the second case, each piece will be composed of gold made standard by silver and copper, coated with gold, alloyed with $\frac{1}{24}$ of silver, or with half of the standard proportion of alloy, supposing the silver and copper to have been in equal quantities; as therefore the standard gold, of which the pieces consist, is always more or less of a deeper colour than the coating or film of the finer gold which covers each piece, it must be evident, that when this coating has been rubbed and removed from the raised or prominent parts, these will appear of a very different and deeper colour than the flat part or ground of the coin.

The

The reason is therefore sufficiently apparent, why gold, which is alloyed with silver, cannot be liable to this blemish.

K. Upon a comparison of the different qualities of the three kinds of standard gold which have lately been mentioned, it appears (strictly speaking) that gold made standard by silver and copper is rather to be preferred for coin; but as gold made standard singly by copper is but very little inferior in its general properties, it may be much questioned whether the few and small advantages possessed by the former would compensate the additional expense of the silver required for half of the alloy; and it may be farther remarked, that any extraordinary addition of silver appears to be less necessary, as there is commonly some of that metal in the gold which is sent to the mint, and which, being reckoned as part of the alloy, must be productive of advantage.

L. When a general view is taken of the results, there does not appear to be any very great or remarkable difference in the comparative wear of the above three kinds of standard gold, all of which suffer abrasion slowly, and with great difficulty; and (as has been already observed) the difference of wear between the two last-mentioned is certainly but inconsiderable; for these reasons therefore, and from the consideration of every other circumstance, it cannot be doubted that the very great loss which the gold coin of this kingdom is stated to have sustained within a certain limited time, cannot, with even a shadow of probability, be attributed to any important defect in the composition or quality of the standard gold, and all that can be said upon this subject is, that some portion of this loss may have been caused by the rough impression and milled edge now in use, by which each piece of

coin acts, and is acted upon by the others, in the manner of a file.

The loss thus occasioned cannot however be considerable, for the quality of the present standard gold is certainly well adapted to resist abrasion, especially in the case of the friction of coin against coin, and this is strongly corroborated by the observation of bankers and others, who are in the habit of sending or receiving large quantities of gold coin from any considerable distance.

When a number of guineas, rather loosely packed, have been long shaken together by the motion of a coach or other carriage, it has been observed, that the effects of friction chiefly fall upon only a few of the pieces; but it is very remarkable, that although these are often reduced nearly or quite to the state of plain pieces of metal or blanks, yet, upon being weighed, they are found to have sustained little or no loss; and from this it appears, that the impressions have been obliterated not by a real abrasion of the metal, but by the depression of the prominent parts, which have been forced into the mass, and are reduced to a level with the ground of the coin.

Pieces of hard gold would not so easily suffer by depression, but the real loss would probably be greater, they being (in the case of the friction of coin against coin of a similar quality) more susceptible of abrasion.

Upon the whole, there is every reason to believe, that our gold coin suffers but little by friction against itself, and the natural and fair wear probably arises principally from extraneous and gritty particles, to the action of which the coin may occasionally be exposed in the course of circulation; but it is nevertheless certain that the united effects of every species of friction to which coin may

may be subjected fairly and unavoidably during circulation, cannot produce any other wear than that which is extremely gradual and slow, and which will by no means account for the great and rapid diminution which has been observed in the gold coin.

Description of the Instruments employed in the Experiments on the comparative Wear of Gold when alloyed by various Metals.

In the first series of experiments, twenty-eight pieces of coin were fixed to a frame, and over each of them was placed another piece, which was pressed against it by a weight. These upper pieces were all connected to a second frame, so that, in consequence of the motion communicated thereto by cranks, each upper piece was rubbed backwards and forwards upon that which was under it.

Fig. 1, (Plate II.) represents a plan of this instrument; and Fig. 2 is a vertical section of it, drawn parallel to the line A B.

The upper frame, or that to which the upper pieces of coin are connected, is of brass, and consists of four bars, Fig. 1, A B, B *b*, *b a*, and *a* A, with three cross bars C *c*, C *c*, C *c*.

The lower frame consists of a board, placed immediately under the upper frame, and is expressed in Fig. 2, by the letters L L.

The upper frame is supported by two vertical boards, extending the whole length of the sides B *b* and A *a*, so that the ends of them are seen in Fig. 2, and are denoted by the letters D D, D D. These boards are fastened to the upper frame, and to the table upon which the apparatus stands, by hinges, so that the upper frame can move freely in the direction B A, but can have no motion in the direction perpendicular thereto. These vertical boards

boards are omitted in Fig. 1; for, as the intention of this description is not to give a detail of all the parts of the instruments, but only to explain their manner of acting, I have taken the liberty to omit such parts as tended to produce an intricacy in the figures, without being necessary to this object.

The disposition of the pieces of coin on the frames is represented in Fig. 1. N *n n*, denote one of the connecting pieces, by which the upper pieces of coin are connected to the upper frame, and in which the small circle represents the position of the coin; the large circle is the part which supports the weight, and *n n* the part by which it is connected to the upper frame.

To avoid confusion, neither these connecting pieces nor the pieces of coin are represented in Fig. 2; but, instead thereof, a section of one of these pieces is given in Fig. 3, upon a larger scale.

In this figure L L is the lower frame, and C one of the bars of the upper frame; *y*, is one of the lower pieces of coin, which is bedded and fixed firmly in a brass socket *x*, fastened to the lower frame; *u*, is the piece of coin to be rubbed against it, which, in like manner, is fixed in another brass socket *w*; N *n*, is the connecting piece by which this socket is connected to the bar C of the upper frame. This piece turns on pivots, in two studs *n*, fixed to the bar C, so that it can turn freely on those pivots in a vertical direction, but cannot be perceptibly shaken horizontally.

Z is the weight by which this connecting piece is pressed down; it is round, and is placed with its center exactly over that of the socket *w*.

It must be observed that, in the construction of this machine, three things principally demanded attention.

1st. That

1st. That the pieces of coin should all move equally.

2dly. That they should all be pressed against the lower pieces by the same weight. And,

3dly. That they should bear flat against them.

As to the first requisite, it is evident that the pieces must all move alike, excepting so far as proceeded from the springing of the parts of the machine, or from the shake in its joints, both of which were very small.

Secondly, as the connecting pieces move freely in a vertical direction, it is clear that the force with which the upper piece of coin is pressed against the lower one, depends only on its own weight, on that of the socket *w*, on that of the connecting piece N *n*, and on the weight Z, by which it is loaded; so that the second requisite is thus easily obtained.

Thirdly, the connecting pieces N *n* bears against the socket *w* only by the pin *p*, which enters into a hole in the centre of the socket, so that the two pieces must necessarily bear flat against each other; but as this pin alone would not have prevented the socket from turning round on its centre, two other pins π π were fixed into the connecting piece, and entered into slits made in the socket near its circumference, allowing no more shake than was necessary to prevent it from sticking; and thus the motion round the centre was effectually prevented.

It may be observed, that the pieces might have been made to bear flat against each other by fixing the sockets *w* in gimbals; but as the method above described was effectual, and much easier made, it was preferred.

It may be also remarked, that the breadth of the bars C *c*, as represented in Fig. 1, is not sufficient to prevent them from springing considerably; for this reason, a method of strengthening them was employed, which answered

swered the purpose perfectly well, but is omitted in the drawing, as it could not be easily represented.

It was at first intended, that the lower frame should have remained fixed, and that only the upper one should have moved; but, in a previous trial, in which two pieces of metal were rubbed backwards and forwards upon each other in the same line, with a view to discover what weight would be necessary to make the pieces wear tolerably fast, I found that for a time they diminished slowly, but that little furrows or gullies were soon worn in them, and that then the diminution was rapid. I also observed, that the gullies in the upper pieces corresponded to those in the lower ones; so that it was impossible that the pieces of metal should touch each other in those places where the diminution was most rapid, and consequently the gullies must have been formed by the particles of metal which had been abraded, and which subsequently had become accumulated.

It seemed to me, that the most probable way to prevent the little furrows or gullies from being thus formed, would be, to construct the instrument in such a manner, that the direction in which the pieces rubbed upon each other should continually vary. The following contrivance was therefore adopted, by which the pieces were prevented from rubbing together twice in the same direction.

In this method, the lower frame, as well as the upper, is supported on two moveable vertical boards; but, whereas the boards supporting the upper frame are placed parallel to B *b*, in consequence of which the frame can move only in the direction B A, these are placed parallel to B A, so that the frame can move only in the direction B *b*.

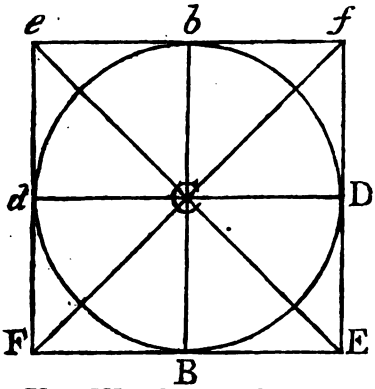
E E,

E E, is the axis by which the upper frame is moved: this turns in fixed sockets at S S, and is turned at each end into the form of an eccentric circle, which acts as a crank; so that, by means of the levers E K, which at one end turn on these eccentric circles, and at the other end turn on joints fixed to the upper frame; this frame is made to move one-fourth of an inch in the direction B A, during one-half of the revolution of the axis, and as much in the contrary direction, during the other half revolution.

e e, is an axis of the same kind, serving to move the lower frame. H H is a windlass, which turns these two axes by means of the toothed wheels F *f*, which work in the toothed wheels G *g*, fastened to the axes E E and *e e*. T T T T T is the table upon which the apparatus stands.

The wheel F has ninety teeth, *f* has seventy-five, and G *g* have each twenty; so that the axis E E makes six revolutions while *e e* makes five; and, at a medium, these axes make about four revolutions to one of the windlass. A counter is placed so as to show the number of revolutions of the windlass.

If the two frames had performed their vibrations in the same time, no advantage would have been gained, for



the pieces of coin would still have moved upon each other always in the same line; but, as their vibrations are performed in different times, the effect is quite different; for let C, in the annexed figure, be the centre of one of the pieces in the lower frame. Draw the lines

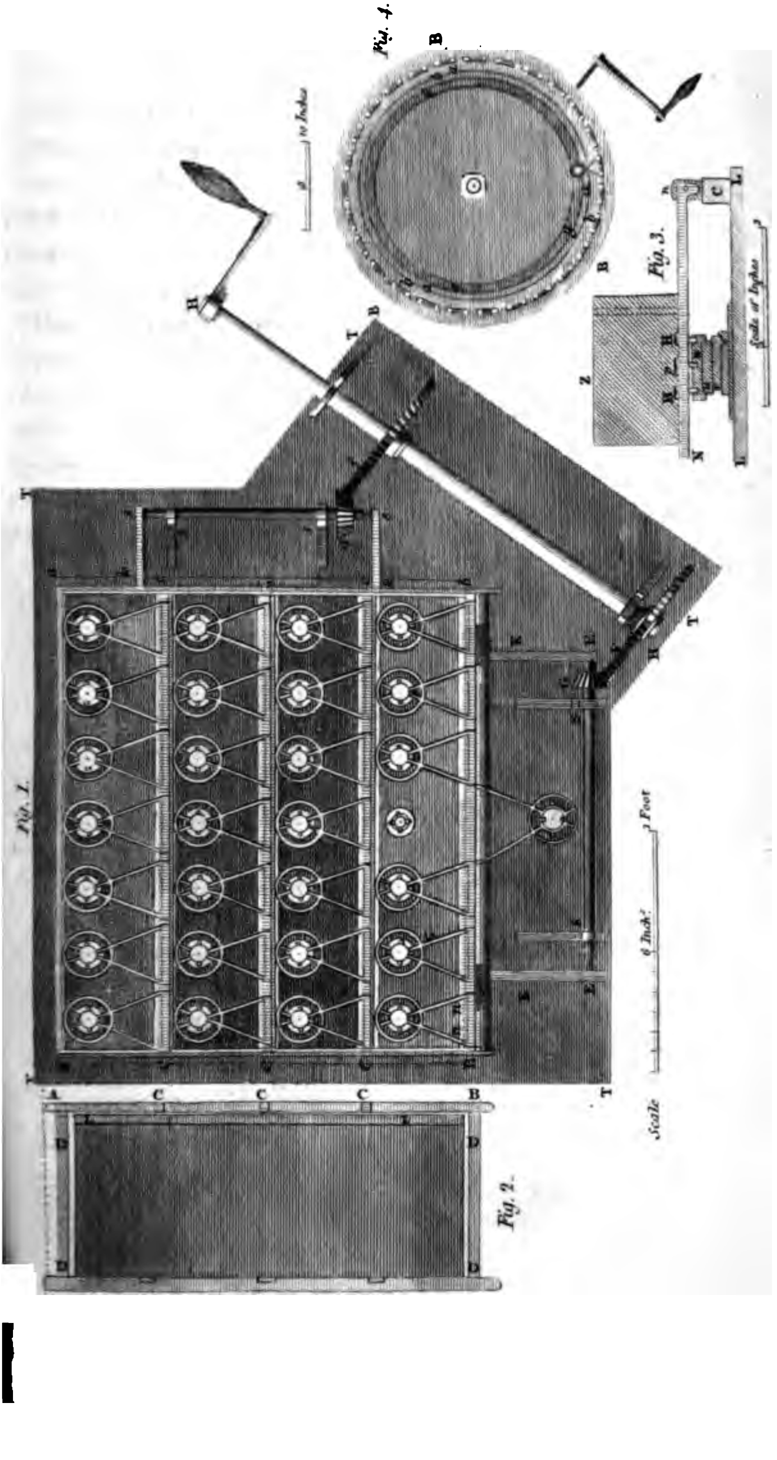
lines B *b* and D *d* in the directions of the motion of the lower and upper frame, and equal to the space which those frames describe in one semi-revolution of the cranks, and complete the square of *e f* E F. Then, if the upper frame is moving with its greatest velocity in the direction D *d*, at the same time that the lower one is moving with its greatest velocity in the direction B *b*, the motion of the upper piece on the lower one will be in the diagonal *f* F; but if, at that time, the lower frame is moving with its greatest velocity in the contrary direction *b* B, the motion will be in the other diagonal E *e*.

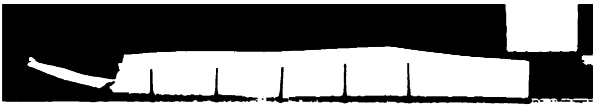
If one frame is moving with its greatest velocity while the other is at the extremity of its vibration, the motion will be in the circumference of the circle *b* D B *d*, inscribed within the square; and, in the intermediate cases, it will be in the circumference of an ellipsis, which is inscribed in the same square, and whose axes are in the diagonals *e* E and *f* F, but in which the proportion of the axes is continually changing; that axis which is placed in F *f* being sometimes the greatest, and at other times the least.

This contrivance, therefore, effectually prevented the pieces from moving upon each other always in the same line; and it seems also to have much diminished the disposition which they had to wear in gullies, but not intirely; for, from the following experiments it appears, that still some few particles would become occasionally collected, and then acted as a grinding powder, which accelerated the wear of the pieces. This was observed particularly to happen to the pieces of gold alloyed with an equal proportion of copper, and to the pieces of copper which were also more frequently worn in furrows or gullies, than the other pieces of more ductile metal.

The

Pl. II. Vol. VI. Second Series.





The motion of the pieces of coin upon each other is greater than it would have been if only one frame had been made to move nearly in the proportion of three to two; so that the whole motion of the pieces, in each semi-revolution of the axes E E or *e e*, is about three-eighths of an inch, and therefore it is about three inches in each revolution of the windlass.

The instrument employed in the second series of experiments is so simple as not to require any drawing. It consisted only of a cubical box of oak, which measured eight inches each way within side. This box was moved by the axis E E of the former instrument, which was passed through the middle of two opposite sides, and was fixed in that position.

Fig. 4 represents a plan of the instrument used in the third series of experiments. *a a a*, is a horizontal table, turning upon a vertical axis; and B B B *b b b* is a fixed frame surrounding it.

The pieces of coin are fastened to this fixed frame by the same connecting pieces which were formerly employed, and are pressed down also by similar weights. The diameter of that part of the wheel against which the centres of the pieces of coin are pressed is twenty nine inches; so that, while this wheel makes one revolution, the pieces are rubbed against it through the whole circumference of this circle, that is through $91\frac{1}{10}$ inches.

A shallow groove *g g g* is cut in this wheel, in that part against which the pieces are pressed, in order to confine the powders employed in the experiments; and the number of revolutions of the wheel are marked by a counter.

Hints regarding Cattle. By Sir John Sinclair.

From Essays on Miscellaneous Subjects.

INTRODUCTION.

THE object that every intelligent farmer ought to have in view, who breeds and maintains domestic animals, *is profit;* consequently he ought to find out, as Bakewell happily expressed it, "*the best machine for* "*converting herbage, and other food for animals, into* "*money.*"

For that purpose, it is necessary to ascertain the shape and nature of the animal which makes the most profitable use of the food it eats: that, however, must depend much on the price of the different articles which the animal produces. For instance, tallow formerly bore a higher price than meat, and consequently was a greater object in the breeding of cattle and sheep than at present, when it sells at an inferior price *, and the various articles produced from it have become so valuable, as to render a good dairy-cow the most profitable of all our domestic animals, and consequently entitled to peculiar

* It would be a curious and important subject of inquiry, to endeavour to ascertain the real price, *and the relative value*, of beef, tallow, and leather, at different periods, more especially within the last century. It is evident, that the farmer must always aim at producing those articles which will yield him the greatest profit; and at present flesh must be the object; for my butcher informs me, that on the day on which this note is written, (25th January, 1802,) beef is sold at 9½ d. per lb. and tallow at 5¾ d. per lb. or 3 s. 11 d. per stone. Flesh consequently is to tallow as 38 is to 23. It is therefore for the advantage of the farmer, as the market now stands, to produce flesh rather than tallow.

atten-

attention *. Meat, however, is at present the object most generally attended to; and it is certain that the breeding of cattle and sheep for the shambles was never carried to such perfection as it has lately been brought to in England.

The cause of this it may not be improper briefly to explain.

Stock, in general, (and this is still the case in a multitude of instances, and must always be so when the breeder has not food at command, calculated for fattening as well as rearing his cattle,) was formerly bred by one set of men, fattened or prepared for the market by a second, and killed by a third †. Whilst these three occupations continued distinct, with only occasional communications or intercourse with each other, no great improvement could be effected. That division of labour,

* It is much to be regretted that the real value of a good dairy-cow is not more generally known. I am assured, by a most respectable country gentleman, (Walter Trevelyan, Esq. of Nether Witton, in Northumberland,) that a well-bred Teeswater cow will give, on an average, fourteen quarts at each of two milkings, or twenty-eight quarts per day. Some of the Teeswater breed, according to Culley (page 40), give even to the amount of thirty-six quarts per day. But calculating at twenty-eight quarts, this, at 4 d. per quart, amounts to 9 s. 4 d. per day, and in six months to 84 l. Another intelligent gentleman, who has had great experience in cattle-farming, observes, that any cow, at all calculated for the dairy, will, in seven months milking, pay double her price to the butcher. Take, for example, an Irish or Scotch cow, calving in May, and value the grass she eats at 3 l.; if she gives from ten to twelve quarts per day the farmer will not only be indemnified for attendance, rent, &c. but at the end of the season he will have the cow for nothing. Can there be a greater inducement to dairy-farming.

† The intermediate occupations of drovers, salesmen, &c. have no occasion to acquire any peculiar knowledge (excepting as to the state of the markets in various parts of the kingdom) different from that of the other professions above mentioned.

or

or separation of professions, so useful in manufactures, was pernicious to this important branch of agriculture, by preventing the principles on which the improvement of our domestic animals might be effected from being ascertained *.

A person, however, of strong natural sagacity, (Robert Bakewell, of Dishley, in the county of Leicester,) though he did not unite to the extent that his disciple, Culley, has done, the two distinct occupations of breeder and grazier, yet having acquired great skill in grazing, by preserving his breeding-stock in the highest possible condition, and having called in to his aid all the skill and experience which the butcher had acquired, was thus enabled to ascertain the principles, not only of breeding domestic animals, so as to answer the common expectations of the farmer, but also of bringing them to a degree of perfection, of which, before his time, they were scarcely supposed capable: and by directing the public attention in general, and that of the farmer in particular, to the art of breeding, he has in various respects most essentially benefited his country. By his example that most important system was very generally established, of certain breeders directing their whole attention to the rearing of males, and letting them for the season, at such prices as would amply indemnify the breeder for all the care and expence he had bestowed upon them; a practice which had originally taken place in Lincolnshire, but had never been carried to any great height till adopted by Mr. Bakewell.

* But when the properties essential in forming a perfect breed are fully ascertained, the separation of occupations above alluded to will become useful, as one farm may be better calculated for breeding, another for fattening, &c.

In

In discussing the important subject of cattle, it is proper, in the first place, to observe that a distinct breed of cattle may be formed, 1, in consequence of the soil of the country, and the vegetables it produces; 2, from the climate, which, in various respects, must affect the animals living under its influence; 3, from a particular shape, size, or colour becoming fashionable, and consequently in great demand; 4, from the nature of the animals that may be imported into it from other counties; and, 5, from the various crosses which have been made among breeds in some respects distinct, and from which a new variety may arise.

It is not proposed, however, to attempt any particular enumeration of the various breeds in these kingdoms; for though differing in regard to colour, size, &c. they claim, in many respects, the same valuable properties.

The great object, therefore, to ascertain is, what particulars are essential to form a perfect breed; because, if these are once pointed out, there is no sort that may not be improved by attentive breeders, either by crossing with other stock, or by selecting the best specimens of the breed itself, so as to acquire the qualities that may be wished for. These particulars may be considered under the following general heads, namely. 1. Size. 2. Shape. 3. Disposition. 4. Hardiness. 5. Aptitude to feed. 6. Early maturity. 7. Milk. 8. Quality of flesh. 9. Fat. 10. Hide. And, lastly, Fitness for working.

Of the Particulars essential in forming a perfect breed.

1. *Size.* It is difficult to lay down any general rule for the size of cattle, as so much must depend on the nature of the pasture, and on the means which the grazier has for ultimately fattening them; nor has it yet been proved,

proved, by decisive and repeated experiments, whether the large or the small sized pay best for the food they eat. The experiments ought to be made with similar breeds, but of different sizes, and the particulars to ascertain are, whether it does not require a much greater quantity of food, 1, to rear a great ox than a small one; 2, to feed him when working; and, 3, to fatten him afterwards. A large calf certainly requires more milk than a small one, but if it pays as well for what it consumes, or grows in proportion to what it takes, there is no objection, on that account, on the score of profit; nor if a large ox eats more, provided he works proportionally more than a small one. In regard to fattening, the experiments of Lord Egremont are rather favourable to the opinion, that fattening stock do not eat in proportion to their weight, but that a small ox, when kept in a stall, will eat proportionally more, without fattening quicker than a large one.

Without pronouncing decisively on a question so much contested, as whether large or small cattle ought to be preferred, (which will require indeed a great number of experiments finally to determine,) I shall endeavour shortly to sum up the arguments made use of on either side.

In favour of small or moderate sized cattle, it is contended, 1. That a large animal requires proportionally more food than two smaller ones of the same weight. 2. That the meat of the large animal is not so fine grained, and consequently does not afford such delicate food. 3. That large animals are not so well calculated for general consumption as the moderate sized, particularly in hot weather. 4. That large animals poach pastures more than small ones. 5. That they are not so active, consequently not so fit for working. 6. That small cows, of the

the true dairy sort, give proportionally more milk than large ones. 7. That small oxen can be fattened with grass merely, whereas the large require to be stall-fed, the expense of which exhausts the profit of the farmer. 8. That it is much easier to procure well-shaped and kindly-feeding stock of a small size than of a large one. 9. That small-sized cattle may be kept by many persons who cannot afford either to purchase or to maintain large ones; and, lastly, if any accident happens to a small-sized animal the loss is less material *.

In favour of the large-sized, it is on the other hand contended, 1. That without debating whether from their birth till they are slaughtered, the large or the small ox eats most for its size, yet that, on the whole, the large one will ultimately pay the farmer as well for the food it eats. 2. That though some large oxen are coarse-grained, yet that where attention is paid to the breed, the large ox is as delicate food as the small one. 3. That if the small-sized are better calculated for the consumption of private families, of villages, or of small towns, yet that the large ox is fitter for the markets of large towns, and in particular of the metropolis. 4. Even admitting that the flesh of the small-sized ox is better when eaten fresh, yet the meat of the large-sized is unquestionably better calculated for salting, a most essential object in a maritime and commercial country, for the thickest beef, as Culley (p. 47) justly remarks, by retaining its juices when salted, is the best calculated for long voyages. 5. That the hide of the large ox is of infinite consequence in various manufactures. 6. That where the pastures are good, cattle

* There is a number of important observations on the size of cattle in Dr. Anderson's Recreations, vol. III. p. 1; and, on the subject of the dairy, p. 161. 241. 321. 401, and vol. IV. p. 1 and 81. See the eighth volume of the first series of this work.

will increase in size, without any particular attention on the part of the breeder, which proves that large cattle are the proper stock for such pastures. 7. That the art of fattening cattle by oil-cake, &c. having been much improved and extended, the advantage thereof would be lost, unless large oxen were bred, as small ones can be fattened merely with grass and turnips. And, lastly, that large cattle are better calculated for working than small ones, two large ones being equal to four small ones, in the plough or the cart.

Such are the arguments generally made use of on both sides of the question; from which it is evident that much must depend upon pasture, taste, markets, &c. But, on the whole, though the unthinking multitude may admire an enormous bullock, more resembling an elephant than an ox, yet the intelligent breeder (unless his pastures are of a nature peculiarly forcing) will naturally prefer a moderate size for the stock he rears; or, perhaps, may adopt that plan of breeding, according to which the males are large and strong, and the females of a small size, yet not unproductive to the dairy *.

2. *Shape* †. It is extremely desirable to bring the shape of cattle to as much perfection as possible; at the same time profit and utility ought to be more attended to than

* See Mr. Knight's valuable account of the Herefordshire breed. Communications to the Board of Agriculture, vol. II. p. 172. The Herefordshire, Devonshire, and Suffex, resemble each other much in this respect.

† It is a common saying with farmers, "*that all breed goes in at the mouth*," and it is certain that no animals can be well shaped unless they are well fed, both in summer and winter. It is almost incredible how much the same breed will improve when they are better taken care of. That, however, ought neither to prevent selection nor judicious crossing.

than mere beauty, which may please the eye but will not fill the pocket, and which, depending much upon caprice, must be often changing.

As to the shape of cattle, however, breeders seem to concur in regard to the following particulars, to wit, 1. That the form ought to be compact, so that no part of the animal should be disproportioned to the other. 2. That the carcase should be deep. 3. Broad. And, 4. That the head, the bones, and other parts of little value, should be as small as possible.

It is evident, however, that the form ought to be adapted, as much as possible, to the wishes of the consumer. For instance; if cattle are to be sold in London, or in other places, where beef for rump-steaks is much in demand, and sells higher than any other parts of the carcase, that is an object to be attended to in cattle bred for the Smithfield, or any similar market, which would not be essential in other counties where no such distinction is made in the meat that is consumed.

3. *Disposition.* It is of great importance to have a breed distinguished by a tame and docile disposition, without however being deficient in spirit. Such a breed is not so apt to injure fences, to break into other fields, &c.; and unquestionably less food will rear, support, and fatten them. As tameness of disposition is much owing to the manner in which the animal is brought up, attention to inure them early to be familiar and docile cannot be too much recommended.

4. *Hardiness.* In the wilder and bleaker parts of the country, hardiness of constitution is a most important requisite; and, even where stock is best attended to, it is of essential consequence that they should be as little liable as possible to disease, or any hereditary distemper; as be-

ing *fiery*, or black-fleshed *, or having yellow fat †, and the like. It is a popular belief, that a dark colour is an indication of hardiness; and that cattle with light colours are softer and more delicate. A rough pile is also reckoned a desirable property in a Highland breed; and, above all, *in out-winterers*, as they are called, or cattle kept out all winter, those who will face the storm, and not those who will shrink from it, are in request ‡.

5. *Easily maintained.* It is well known, in the human race, that some individuals eat a great deal, and never get fatter; whilst others, with little food, grow immoderately corpulent. As the same takes place in regard to cattle and to other animals, it is evident how important it must be to ascertain the circumstances which produce a property so peculiarly valuable in them. Bakewell strongly insisted on the advantage of small bones for that purpose; and the celebrated John Hunter declared, that small bones were generally attended with corpulence in all the various subjects he had an opportunity of examining. It is probable, however, that a tendency to fatten arises from some peculiar circumstance in the internal structure of the body, of which small bones are, in general, an indication; and that it is only in this point of view that they ought to be considered essential, for they often weigh as heavy, and consequently require as much nourishment as large ones. Small bones, like those of the blood horse, being compact and heavy: large bones, like

* Culley on Live Stock, second edition, p. 48. It is singular that these black-fleshed animals have little or no fat within or without.

† See Middleton's Middlesex, p. 576.

‡ It is remarked in the Highlands, that in bad weather hardy cattle keep their back-bones straight, whereas soft ones bend them. Hence the crooked appearance of bad cattle.

those

those of the common dray or cart horse, being extremely porous, and consequently light for their apparent bulk. Indeed, cattle ought not only to be easily maintained, in point of quantity, but, in remote and uncultivated districts, in regard to the quality also of the food they consume ; and it is certain, that some particular animals will fatten as well on coarse fare as others will do on the most luxuriant.

6. *Early maturity.* Arriving soon at perfection is a material object for the breeder, as his profit must in a great measure depend upon it. This is a circumstance indeed not only extremely material to the farmer, but in a populous country, where the consumption of meat is great, to the public also ; as it evidently tends to furnish greater supplies to the market. In regard to this point, however, some wish to make a distinction between sheep and cattle ; as the latter, they affirm, might pay for its keep by working or by milk. But is not the farmer indemnified for the expense of maintaining sheep by the valuable manure it yields, and the fleece which it annually produces, which, when manufactured, is the source of such profit to the community * ?

7. *Milk.* The dairy is such an object in many parts of the kingdom, and it is so desirable to have a living machine that can convert, in abundance and perfection, the food it eats, to so useful, so profitable, and so essential an article as milk, that the breed the most distinguished for that property must always be in request. Whether a particular breed ought to be kept up for that sole purpose,

* In regard to early maturity, both as to sheep and cattle, it evidently depends much on the animal being constantly kept in the best possible order, for if it is once suffered to fall back, it requires a considerable space of time, and much trouble and expense, before it can recover what it has lost.

pose,

pose, or whether it is preferable to have stock partly calculated for the butcher and partly for the dairy, is a point well entitled to the most deliberate discussion. It is probable that, by great attention, a breed might be reared, the males of which might be well calculated in every respect for the shambles, and the females of which might, when young, produce abundant quantities of good milk, yet when they reached eight or nine years of age might be easily fattened. This would be the most valuable breed that could be propagated in any country, and indeed some of the best English and Scotch breeds have almost reached that point of perfection.

8. *Quality of Flesh.* The quality of the flesh must certainly depend much upon age and sex, as old cattle must have firmer flesh than young, and heifers must be finer grained than oxen. The excellence of the meat also must depend much upon the size of the animal, and the food on which it is fattened. On the whole, however, there is no better sign of good flesh than when it is *marbled*, or the fat and lean nicely interwoven, and alternately mixed with each other. Some of the Scotch breeds, (the most northerly in particular,) when properly fed, and when they arrive at a proper age, enjoy this quality in great perfection; and hence there cannot be either wholesomer food, or more delicious eating.

9. *Fat.* The advantages or disadvantages of fattening cattle and sheep, at least to the extent usually practised at present, is a point that has of late attracted much public attention. But any controversy upon that subject must necessarily arise from want of proper discrimination. Fat meat is generally accounted more nourishing than lean; but then none, except persons in the most vigorous state of health, can digest it; consequently it is unfit for general consumption. Dr. Willich, in his Lectures on

Diet

Diet and Regimen, very justly observes, "that though "fat meat is more nourishing than lean, (fat being the "cellular substance of animal jelly,) yet, to digest this "oily matter, there are required, on account of its dif"ficult solubility, a good bile, much saliva, and a vi"gorous stomach *." Fat meat also, unless prepared with peculiar care, is apt to lose much in cooking; but there are modes by which no loss is sustained in dressing it, which remove that objection. For instance, the keelmen of Newcastle purchase great quantities of fat meat. Being generally of Scotch extraction, they follow the custom, so usual in Scotland, of boiling their meat; the broth of which feeds the family, whilst they themselves eat the meat, generally in a cold state, and in great quantities, and are thus enabled to go through the heavy labour they usually undergo. In many districts manufacturers and others bake their meat with potatoes under it, and the fat, melted by the fire, falls upon the potatoes, and improves much their taste, and the nourishment to be derived from them. In either of these ways, little, if any, of the substance of the meat is lost. But, according to the usual mode of boiling or roasting fat meat, the loss is considerable, and the meat itself is far from being well calculated for nice or delicate stomachs. The art of fattening animals, however, is one that seems fit to be encouraged, as likely to promote useful knowledge; and although, in the course of trying a number of experiments, some excesses may be committed, yet, on the whole, much advantage must be derived from them.

* Willich's Lectures on Diet and Regimen, third edition, page 316. Dr. Stark's experiments go to prove, that three ounces of the fat of boiled beef is equal to a pound of lean. See a tract, printed An. 1801, intituled, "Practical Economy," &c.

10. *Hide.*

10. *Hide.* It is well known, that the grazier and the butcher judge of the aptitude that any animal has to fatten from the touch of the skin. When its hide feels soft and silky, it strongly indicates a tendency in the animal to take on meat; and it is evident, that a fine and soft skin must be more pliable, and more easily stretched out to receive any extraordinary quantity of flesh, than a thick or tough one. At the same time, thick hides are of great importance in various manufactures. Indeed they are necessary in cold countries, where cattle are much exposed to the inclemency of the seasons; and in the best breeds of Highland cattle, the skin is thick in proportion to their size, without being so tough as to be prejudicial to their capacity of fattening. It appears, from Columella's description of the best kind of ox, that the advantage of a soft skin is not a new discovery, but was perfectly well known to the husbandmen of ancient Italy.

Lastly, *Working.* It is a most important question, not yet finally ascertained, whether the public or the individual gain by working oxen *. In the infancy of agriculture,

* It is ingeniously remarked, that the working of oxen must necessarily increase the number, and only *suspends* the consumption. In the Survey of Northumberland, by Messrs. Bailey and Culley, some calculations will be found extremely unfavourable to the working of oxen. In fact, it is a general and complicated subject; as the question is not, whether oxen or horses can be worked at the least expense, but whether, by working horses, and feeding oxen, more butcher's meat will not be sent to the market? as oxen, when not worked, may be ready for consumption so much earlier than otherwise can possibly be effected. In favour of oxen, it is to be observed, that a ruminating animal will be served with one-third less food than another of equal bulk, that does not possess that property. The reason is, that ruminating animals have stronger digestive organs, and every thing capable of being

ture, when husbandmen had inconsiderable capitals, and little work to do, it might be for their interest to use oxen, as they were cheaper to rear and to maintain, and would always fetch something. But the great farmers of modern times, who have large capitals to act upon, and constant occupation for their teams, will generally find it advisable, though they may employ oxen for some purposes, yet, on the whole, to make use of horses. At the same time, the population of a country may increase so much, that the ground must be cultivated, either by the hands of man, as in China, or by animals which man will eat; and the price of beef may become so high as to cast the balance in favour of oxen. On these grounds it is desirable, that the general breed of cattle in a country should be capable of working. Indeed, as stock ought to produce something, even when rising to their full growth, if oxen are not to be worked, cows ought to be more generally kept, as the produce of their milk is so profitable, unless where pasture is of little value, as in Wales, or the mountainous districts of Scotland and Ireland.

These short hints contain the substance of what has occurred to me on the principles of breeding cattle; and the result is, that cattle ought to be,

1. Of a moderate size, unless where the food is of a nature peculiarly forcing.

2. Of a shape the most likely to yield profit to the farmer.

ing converted into chile, or nourishment, is extracted from the food. But a horse's stomach is not fitted for this; so that a greater quantity of food is necessary to extract the same nourishment. See White, on the Natural History of the Cow; Manchester Memoirs, vol. I. p. 442.

3. Of a docile disposition, without being deficient in spirit.

4. Hardy, and not liable to disease.

5. Easily maintained, and on food not of a costly nature.

6. Arriving soon at maturity.

7. Producing considerable quantities of milk.

8. Having flesh of an excellent quality.

9. Having a tendency to take on fat.

10. Having a valuable hide. And,

Lastly, calculated (should it be judged necessary) for working.

CONCLUSION.

I shall conclude with observing, how desirable it would be that, under the auspices of the Board of Agriculture, some person were appointed, perfectly competent to the task, and who had leisure to do justice to such an undertaking, to whose care and talents the important task might be committed of drawing up a detailed system on the subject of cattle. But in order to make such a work complete, more especially that part of it which relates to the diseases of cattle, it would be necessary to collect intelligence, not only from every district in these kingdoms, (which might easily be done, by circulating queries for that purpose, and granting premiums to those by whom the best answers were returned,) and also to extract useful information from the writings of Young, of Marshall, and of Anderson, and from the various publications of the Board of Agriculture, but to apply even to foreign countries for the knowledge they can furnish; and, with that view, it would be proper to carry on a regular correspondence with the most distinguished societies in foreign parts, who have directed their attention

[redacted]

to rural improvements. By collecting the information and experience of the different countries in Europe upon that, and other subjects of a similar nature, there is every reason to hope that the art, not only of breeding and managing domestic animals, but also every other branch of agriculture might be brought to a degree of perfection, which otherwise must be unattainable.

[*The Appendix to the foregoing Article in our next.*]

On the Means of abolishing the horrid Practice of sweeping Chimneys by Children. Communicated by the Author, in a Letter to the Editor.

With a Plate.

Mr. EDITOR,

NOTWITHSTANDING the great and meritorious exertions which have been made during many years, by the humane part of the public, to abolish the barbarous practice of sweeping chimneys by children — notwithstanding many machines have been invented capable of performing the operation, in most cases, quite as well as children, and in many even better, yet no progress has been made towards accomplishing the salutary end at which all have aimed. The author of this paper, who is one amongst the number who have contributed their aid to this laudable design, and who has bestowed much consideration on the subject, is convinced, from the futility of every attempt yet made, that there is but one way of effectually eradicating this enormous evil, this disgrace to humanity. And when it appears that the means are as simple, and as easily executed, as the object is desirable, it is matter of amazement that this execrable practice has

H 2 remained

remained so long unchecked in a civilized country. Of what avail are useful machines when they are to be put into the hands of those persons whose interest it is to destroy them, or, which is the same thing, of those who, from ignorance or prejudice, feel convinced that such machines if used would abolish the lucrative part of their trade. Such *is* the opinion and prejudice of master chimney-sweepers against the use of any machine. And as all attempts to counteract this prejudice, and to induce them to adopt machinery, have failed, there remains but one remedy for the evil, and that remedy dwells in the powerful arm of the legislature. Nothing less than a positive law to prohibit the employment of children in this trade, with severe penalties both on employer, and master-sweeper, can effect the reform desired. By the help of such a law the object will be instantaneously accomplished. Master chimney-sweepers will immediately find the means of performing this operation by inanimate agents; or, should they be at a loss, the simple methods practised in most country places may be resorted to — a bundle of furze, or other such material, tied to a cord, and pulled up and down the chimney, will answer the end in four cases out of five, even as chimneys are now constructed. But if the legislature would interfere to stop the present evil, it probably would go farther, and lay down rules for future buildings, that should remove all difficulty in the application of machinery (if it is not a burlesque on the word) to the object in question. Rules to this effect I apprehend would easily be formed by any intelligent architect, or by a committee of the most enlightened part of the profession.

But lest I should be suspected of recommending laws to restrain one evil without having discovered the means of preventing another taking place in its room, I beg leave

leave to shew the methods which have occurred to me of accomplishing this very desirable end, and although they may not be the best which can be devised, yet of this I am certain; they are so good that few objections can with justice be opposed to them. This opinion may appear presumptive; but when the reader is informed that all the merit the author of this paper claims is only recommending those rules to be established by law which a very ingenious architect (totally unknown to the author, and probably not now in being) has recommended to the attention of his profession, the appearance of presumption will cease.

The principal object of the architect to whom I allude was the prevention of smoky chimneys in all future buildings; and, in a publication * on that subject, he introduces some remarks respecting the sweeping of chimneys, which I shall take the liberty of copying; as likewise a section of a stack of chimneys, so contrived as, in my opinion, would, if adopted, not only accomplish his first object, but mine also.

REFERENCE to PLATE III.

Fig. 1, is the section of a stack of chimneys, five stories high, for a first-rate house.

A, kitchen-chimney. B, parlour chimney. C, first-floor. D, second-floor. E, garrets.

By this section it will be seen that there are only two easy angles in each chimney, consequently if chimneys are constructed of regular dimensions from top to bottom, either square, oblong, or circular; they may be swept with great facility by any soft elastic substance forced from top to bottom. The circular form will be

* See an "Essay on the Construction and Building of Chimneys, &c." By Robert Clavering.

the

the best, because it will be most completely cleaned by the substance forced down it, and because it is the most difficult for children to ascend. The only objection to it is a trifling extra expense in its first construction. The objection to the square and oblong forms is, that whatever substance is employed to clean them will not so readily accommodate itself to their shape, but will be apt to leave the soot in the angles, and therefore subject to take fire occasionally, or to fall into the fire-place. In other respects, the soot left in the angles would cause no inconvenience, because the smoke ascends in a circular form, and never occupies the angles of the funnel but when forced into them by obstructions to its natural current.

The inside of every chimney should be well plastered (pargeted) with materials that will take a smooth and hard surface *.

If these *rules* were observed in building chimneys, it is plain no great ingenuity would be required to invent proper implements to sweep them; but these rules never will be observed, nor the practice of employing children

* A good plaster is made as follows, viz. to two bushels of good stone lime, add one bushel of fine drift gritty sand, and a like quantity of sea-coal ashes, or brick dust; skreen them fine, beat and incorporate them together, for the first coat; and, when well set, put on the following for the second or finishing coat. Take fine white plaster, (commonly called plaster of Paris,) mixed with stale small beer; and work it well in a trough or tub to a due consistence; then lay on a fine thin coat of it upon the other, carefully worked in, and as smooth and even as possible. In a short time it will assume the hardness of stone, and a polish little inferior to marble. A funnel thus executed and finished can never be the cause of smoke; and if the expense be a trifle more, to a gentleman who desires a well finished habitation, it can be no object.

in

in this barbarous trade ever abolished, without the force of LAW.

With respect to chimneys already built, there would be very little difficulty in sweeping them with furze, &c. provided children were not allowed. Wherever a spherical body not less than six inches diameter would find its way from top to bottom, sweeping by furze, &c. might be performed; and where it would not, the chimney ought to be condemned *; and the district surveyor appointed to inspect and see it repaired; as such obstruction would be evidence, not of its original defective construction, but of some decay that might endanger the house by the soot taking fire.

Chimneys built a century or more ago are very wide at the bottom, and sometimes with ledges, formed by the awkward manner of building in those days; but they are generally within a man's reach, so that if the ball stop there, the soot will also, and can be easily removed.

Mr. Clavering says, no chimney ought to be less than ten inches square, and few will require to be greater than sixteen. If this be confirmed by experiment a very few sizes might be given as general rules, and, if observed by builders, a very few implements would be required by the sweepers to answer the purposes of their trade. For instance, suppose the kitchen chimney sixteen inches square, parlour and first-floor fourteen, bed-chamber twelve, attics ten, thus four tools to fit these chimneys are all that will be necessary. And if circular funnels be constructed an equal number of circular brushes would be required.

* This also requires the force of Law; for, if human beings are not prohibited from this trade, they will be resorted to in these cases, and the chimney will be swept in the usual way, till an accident perhaps destroys the house, &c.

Mr. Clavering says, "the method he would recommend for sweeping circular funnels, is to have a strong round brush, made full to the size of the funnel, and about two feet in length with a staple at each end, for cords to be fastened to: if this is drawn up and down the chimney by a man at the top and another below, the chimney will be swept clean in the most perfect manner, as it is practised in the North of England, where I have been; and, as I am also informed, in Scotland and Ireland. A loose bunch of furze will clean a square funnel equally well. The ready way to perform this operation, is, to drop the lower end of the cord down the chimney to the man below, with a piece of lead or a stone fastened to it, and the brush to be put in at the top, and so pulling up and down by degrees all the way, which will perfectly clean the chimney. If the man below ties his end to a mop-stick, he may play it up and down behind a chimney cloth without injury to his eyes. This method is preferable to sweeping by boys; for the plastering on the inside of the funnel will not be hurt by the brush: but will be liable to be broke by the boys with their iron scrapers and brush heads, who will also be tempted to dig holes in the plaster for their feet. The circular funnels will seldom want sweeping, for being smooth and regular the soot will not adhere to the sides as in the corners of common square funnels: however, no chimney that is used ought to remain unswept once, at least, in the year. The late act of parliament respecting fires in chimney dictates this precaution."

Thus, I flatter myself, it will appear that this great evil may be redressed, without inconvenience or injury to any one, and with a very trifling variation only in the means of carrying on the trade of sweeping. It will continue in the same hands in which it now resides; the

same

Fig. 1.

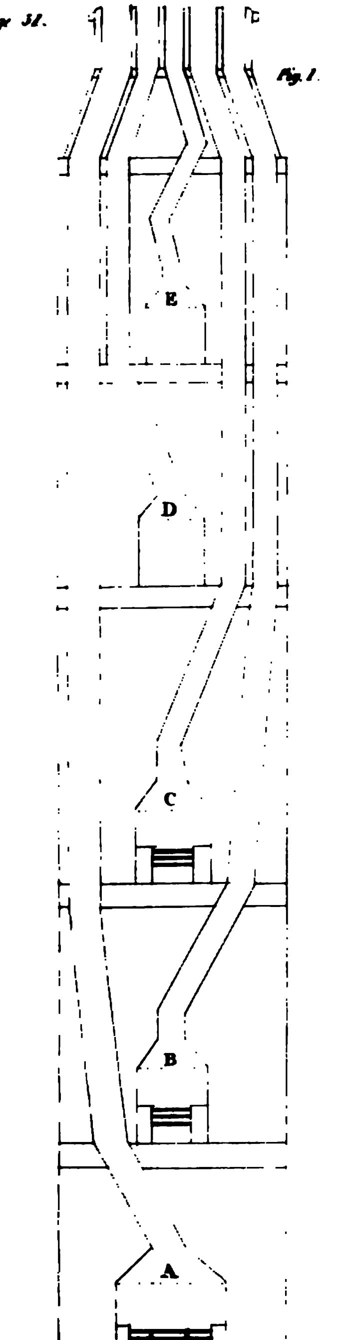
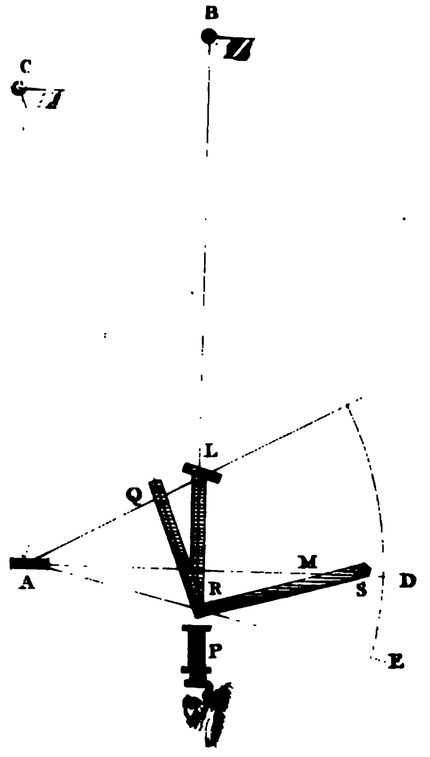


Fig. 2. Page 57.



[redacted]

same apprentices may be employed that are now engaged, but not in the same dangerous and pernicious way; so that the master in the art will have no interest in opposing the alteration of the practice.

The members of parliament who shall be instrumental in forwarding this wholesome law will receive the blessings of those oppressed little beings whom it will relieve, and the praises of all mankind.

On the Employment of the Aërostatic Machines in the Military Science, and for the Construction of Geographical Plans. By A. F. LOMET, *Adjutant-commandant, formerly Keeper of the Models at the Polytechnic School, and now Chief of the Sixth Division of the War Department.*

With a Plate.

From the JOURNAL DE L'ECOLE POLYTECHNIQUE.

AËROSTATION is yet in its infancy; it is therefore of importance to obtain the assistance of learned men and artists in this interesting pursuit; but as investigations in this art are generally too expensive for individuals, it seems necessary that government should support an establishment particularly devoted to the practice and improvement of it.

Aërostats will furnish, in presence of an enemy, one or more points of observation at pleasure, from which the positions he occupies may be reconnoitred, his movements studied, and his manœuvres judged of in the gross, or appreciated in the most minute detail. It may be presumed that these machines will become of the most indispensable utility in war, because they supply it with an extraordinary means, hitherto unknown, of making ob-

servations, which may in an instant determine the fate of battles, secure the dispositions for a vigorous defence, or at least point out the moment and the most convenient outlets for a retreat; and more particularly to draw attention to the advantages which an army may derive from balloons, it will be sufficient to remember the happy use made of them at the battle of Fleurus.

The Committee of Public Safety, and afterwards the Executive Directory, thought that the application of aërostats to military enquiries of every description ought to be studied and practised during peace. They were also desirous, that they might be employed in the construction of geographical plans, or at least in ascertaining the intermediate particulars of the territory between the points which had been geometrically determined. Having been charged with the experiments relative to these different applications, I purpose giving an account of the principal results.

The intention, from the first ascents, was to measure the angle formed by the visual rays falling on the eye of the aërial observer, from several determinate points on the earth. The unavoidable motion of the aërostat preventing the use of the graphometer in this operation, a recipiangle was at first substituted, suspended like a mariner's compass, by the assistance of which it was hoped the measure of the angles would be easily taken, and particularly that they would be obtained with immediate relation to a horizontal plane. This attempt not having succeeded, it was necessary in future to make use of a sextant.

This instrument was every thing that could be desired for celerity, as well as for the facility and precision of the observations, but it has this inconvenience, in the case in hand, that it only shews the angle on a plane inclined to the

[redacted]

the horizon; and moreover, in its ordinary construction, it furnishes no means of noticing this inclination. The perpetual agitation of the machine is another source of error; in fact, an aërostat, kept elevated and held by cords, is continually changing position; it moves in space, describing alternate ellipses, the curvature of which is modified to infinity, according to the violence of the wind, the elasticity of the cords, and the situation of the places to which it is fastened. It leaves then no trace of its variations, and does not permit the observer, which it supports, to add to the measure of any angle whatsoever, that of the two angles necessary to connect the first with the plane of the horizon.

Nevertheless, for plans relative to the generality of military inquiries, and in all cases where a sketch of the figure of the earth is sufficient without attending to slight inaccuracies in distances, simple observations, made with the sextant, will answer the purpose, and furnish the means of operating with facility over a vast extent of territory, secure from the attempts of an enemy. But it is not equally serviceable in operations which require a rigorous exactness, and in which it is requisite to connect the angles with the centre of the station, and with the plan of the horizon.

The following is the mode in which I have endeavoured to fulfil the various objects:

The angles necessary for connecting the position of two objects with the centre of the station and the plane of the horizon, are, first, the angle comprehended between the rays falling on the eye of the observer from these points; second, the angles formed by each of these rays with the perpendicular.—We have seen, that it is impossible for the aërostatic observer to mark these three angles by taking them after each other; but if their measure were instan-

 taneous,

taneous, the difficulty would be overcome. This would therefore be the case if an instrument could be devised, which would give these three angles at once by a single observation; and as the sextant already shows the angle comprehended between the rays, the object in view is to add the necessary parts to that instrument for obtaining the other two at the same time.

Let B A C (Fig. 2, Pl. III.) be the angle formed by the visual rays A B, A C; falling on the mirror A of the sextant from the objects B and C; if the index A D be moved until the image of the object C reflected by the mirror A placed on the index coincides by double reflection on the mirror L, with the point where the object B is seen; and if they be both perceived at the same time by the observer looking through the telescope P, it is known, (by the theory and use of the sextant,) first, that the angle D A E, comprised between the index A D and the fixed radius or line of zero A E of the instrument, is always equal half the angle B A C, the measure of which is required: second, that the line R B, which is supposed to pass through the axis of the telescope and the centre of the mirror L, is always directed to the point B, and is usually taken for the side A B; the error arising from the small distance A R being considered as nothing in practice: hence, if we suppose a visual ray passing from the point R to the object C, the angles B R C and B A C may be reputed equal, and be taken indiscriminately for each other.

This being premised, if a ruler be placed in the direction R B, it may be considered as in that of the side A B, and if we can succeed in fixing a second ruler in such a manner that the moveable index shall carry it into the direction R C, at the instant that the images of the two objects B and C are brought into one at the point L, it

it is evident that these two rulers will form between them the angle B R C, and consequently the angle B A C.

To accomplish this, let us suppose a sort of false square, S R Q, situate in the plane of the instrument, and moveable at its axis on a pivot fixed at the point R, at the intersection of the lines A R and R L; making the angle S R Q, comprised between its arms, equal to the angle E R L, and the side R S equal to the distance A R. If now we suppose that the extremity S of the side R S is retained by a button in a groove M N, worked in the moveable index, the movement of it will be communicated to the false square in such a manner that the angle L R Q will always be equal to the angle B A C, and consequently the side R Q will be placed in the requisite direction.

In fact, the triangle A R S being isosceles in its form, the exterior angle S R E = R A S + A S R. = 2 R A S = B A C; but S R Q being equal to E R L, if the common angle S R L be taken away, there will remain the angle S R E = L R Q = B A C.

Now let us fix, under each of the two rulers R L and Q R a small graduated quadrant, suspended in such a manner that it will place itself in the vertical plane of the side corresponding to the angle observed; let us affix to each of these quadrants a plummet, composed of a stiff arm, moveable upon a pivot, and furnished with a nonius index and a weight, which gives it a constant tendency to assume a vertical position, in whatsoever situation the sextant may be placed; finally, let the whole be so disposed that the index of each plummet may be retained at will, at the division indicated on the limb by the effect of the suspension, and this by means of a trigger, which can be pulled at the exact instant of observing the principal angle in the points of reflection. It is evident

evident that the simultaneous action of the two rulers and the plummets will show the three angles sought, and that nothing remains but to reduce, by calculation, the angle B A C to the plane of the horizon.

This instrument, arranged in the manner here described, produced every desired effect in our experiments. The invention, as simple as it is happy, may become very important from the useful application of which it is susceptible; and there is already reason to hope that, by bringing this to perfection, or by the formation of some analogous instrument hereafter, there will be a possibility of executing trigonometric operations with much correctness, by the assistance of aërostatic machines, notwithstanding their continual motion.

It was not enough to have discovered the means of connecting the angles with the plane of the horizon: it was still desirable, that all the angles observed during ascents in any one place should have a relation to the common centre of observation. To accomplish this, it was necessary to keep a register, by some means, of the situation of the machine at the precise moment of measuring each of these angles. This was done by dropping from the aërostat, at that instant, a small stake, leaded, and furnished with an iron point. This stake fell rapidly to the earth, into which it stuck, and marked a point corresponding to the summit of the angle measured. It was then easy to compare the position of this point with that of one taken for the common centre of the observation, and thence to deduce the necessary corrections. It must however be noticed, that the stake, when abandoned to itself, acquires, at the instant of its fall, a compound motion, which partakes of that of the aërostat, and consequently is not exactly vertical; but the error which results from this deviation is but slightly perceptible in practice.

The

The calculations and ordinary processes of descriptive geometry will furnish all the means of making use of these different observations, and of expressing the results on paper; not only for their application to the construction of maps, but also to ascertain heights compared with the level: but we shall not in this place enter into any details on that head.

The observer engaged making these first experiments, soon perceives that the involuntary embarrassment, occasioned by the novelty of his situation, when he finds himself insulated and suspended at a height of seven or eight hundred metres, has a considerable influence both on the fidelity of his observations and on the time necessary for making them. All certainty depends, in fact, upon the confidence and readiness of the observer; and it cannot be concealed, that it may produce great inconveniences, because this difficulty of operating opens wide limits for the errors which it is possible to commit.

From this last observation it will be seen: first, that it is indispensably necessary to have acquired a great aptitude for these sort of observations, to be able to execute them with precision: second, that the processes just described are more satisfactory in theory than they would be in those applications which require strict accuracy; and that, though there are situations in which nothing can be substituted for their use in the construction of some figured plans, it is at least proper never to use them in preference to those means of observation which are better known, and which can be employed with more certainty.

But it cannot be too often repeated, at the same time, that aërostats furnish the means of giving the most lively interest to the delineation of the figure of the earth, in maps

maps of all descriptions; and that their use is of the greatest assistance in the formation of plans, the outline of which may be sufficiently defined by a simple eye-sketch. The aërial observer, by discovering a vast extent of country, accustoms himself fully to consider the general organisation of the asperities of the country, and even the particulars of its varieties, as well as the tone of colour, which appear to give a different character to each portion of territory. If this new method of observation be cultivated with assiduity, it will doubtless lead to a sensible improvement in the art of drawing plans. But to benefit by the advantages which it affords, it is necessary that those who are destined to this employment should join a profound knowledge of geometry to a great facility in designing landscapes. May they be convinced of the importance of this truth, and assure themselves that no part of the plan can arrive at perfection, either ornamental, or relative to civil and military purposes, unless strict accuracy in the outline is accompanied by that fidelity of expression which is capable of producing in those who inspect the plans, all the ideas which the observer had formed from the aspect of the country.

From all that has been said, we may conclude, that the aërostatic art combines properties no less valuable than unquestionable in topographic operations and military researches; that its perfection may produce new and invaluable properties; and that it would be equally impolitic to neglect the use of these machines, or not to obtain for them the information to be derived from reflection and experience. We shall terminate this memoir by an observation relative to their military uses. Our enemies would not fail to oppose to the creative industry of France, an industry of imitation: they would also have their

[redacted]

their balloons and ballooners. The influence of this innovation in war is of a nature to spread with rapidity, and it must soon cease to favour any nation exclusively. But even in this case the art of aërostatic machines will have acquired a higher degree of interest, because another element will then be in the power of man, in which the efforts of genius and industry may be substituted instead of the inconsiderable devastations of force; and this observation ought to interest the friends of humanity in bringing them to perfection.

Method of procuring very strong Vinegar at a trifling Expense.

From the Bibliotheque Physico-Economique.

THE manufacture of oiled cloths consumes a great quantity of vinegar. The acetite of iron (solution of iron in vinegar) is the material employed in the colouring to obtain from madder all the red-browns and the various shades of violet. These colours are the more brilliant and vivid according to the superior quality of the acid employed.

The vinegar of the shops varies *ad infinitum* both in price and quality; it would therefore be highly advantageous to the manufacturer to prepare himself a vinegar of a good quality, and always of equal strength. The following process promises this advantage. It is extracted from a theoretical and practical course of lectures on painting, held at Berlin, under the auspices of government by that able chemist professor Westrumb.

Take twenty pounds of unripe grapes, together with the stalks; bruise them in a mortar, and put them into a hogshead holding 68 gallons or 272 quarts.

In a boiler of copper, or preferably of tin, boil 150 quarts of river water with four pounds of red tartar. When the tartar is dissolved, add six pounds of common treacle. Pour the whole over your grapes, and lower the temperature by the addition of fifty quarts of cold water and two quarts of yeast. Observe that the vessel be filled only to about an inch below the bung-hole. After having well mixed the composition, remove it to a place where a regular heat of twenty to twenty-five degrees of Reaumur is maintained.

The fermentation takes place in the course of a few days, and continues sometimes for a month. When it has ceased, which may be known by the absence of the froth which covered the liquid and the vinous odour which succeeds the pungent smell it before exhaled; the bung-hole must be closed, and the vessel left perfectly quiet for a fortnight, that the liquor may become clear.

At the expiration of that time draw off the liquor by means of a cock; add eight quarts of brandy and six of common vinegar; place the vessel in a moderately warm situation, in summer under cover; let the liquor be six or seven inches lower than the bung-hole, which must be left open. A few weeks will be sufficient to convert it into very strong vinegar.

As soon as you find it of sufficient strength, remove it into another vessel, and keep it carefully bunged. The prime cost of the Berlin measure, weighing $2\frac{1}{4}$ pounds, is 8 to 10 pfennings, or about one penny of English money.

Memoir on Vinous Fermentation. *By* M. THENARD.

From the ANNALES DE CHIMIE.

VINOUS fermentation being considered of more importance, has hitherto occupied a greater portion of attention than acetous and putrid fermentation. The latter, however, is perhaps, neither less remarkable nor less worthy of reflection, but it is natural to attach more interest and value to what is more immediately useful.

The period assigned to the discovery of vinous fermentation, appears too certain to admit of a doubt. All historians agree in asserting that the most ancient nations knew how to prepare spirituous liquors. It, therefore, originated in the most remote ages; and, it would indeed be surprising if it had escaped the observation of the first of men. An ebullition arising spontaneously in the bosom of a liquid, an entire mass, rising of itself, a sweet liquor becoming vinous, the conversion of a saccharine matter into ardent spirit, is certainly extraordinary, calculated to strike the attention, and to excite a desire of discovering its original cause. Thus, as it is the first phenomenon that fell under the observation of mankind, so none has been the subject of more reflection, or has given occasion to more numerous experiments; and yet, by one of those contracts rarely met with in the annals of science, though the most studied, it is, perhaps, the one with which we are still least acquainted. It has always been a species of rock on which the efforts of chemists of all ages have suffered shipwreck. Becher, so celebrated for his knowledge of subterraneous nature; Staahl, the Nestor of ancient chemistry; Boerhaave, who formed such sublime ideas; Rouelle, to whom the science is indebted for a part of the improvements made in it

during the last half century that has elapsed; Macquer, that master of the art of composition; and many other celebrated chemists, have failed in attempting to develope this mystery of nature. Lavoisier, who knew how to conquer the greatest obstacles, was the only one, who, illuminating the whole science of chemistry with the torch of his genius, proceeded without losing himself in this obscure path. His researches on fermentation will always be a model for vegetable analyses. He blended in them, as in every thing else he did, that closeness of reasoning and accuracy in the operation, which are characteristic of his manner, and may be regarded as the source of the brilliant discoveries that will ever render his name illustrious. Notwithstanding his luminous researches, much still remains to be done, in order to render our knowledge of this subject complete. Though he has thrown much new light on this department of science, yet the obscurity in which it was enveloped was so profound, that it is still seen, as it were, through a cloud; and this truth did not escape that great philosopher. He was well aware that he had only opened the career, which it remained for others to explore: he would, doubtless, have done it himself, he would have completed what he so successfully began, had not death, envious of his fortune and his fame, terminated his labors.

All our knowledge relative to fermentation is, in fact, confined to this point, that the saccharine matter is converted into alkohol and carbonic acid by means of an intermediate body. But what is the nature of that body? How does it act upon the sugar? It is these two great questions that are the subject of this memoir, and which have frequently been treated of, without having ever been resolved. Some have thought that the fermentable principle resided in the extractive matter; others, rejecting

[redacted]

ing that idea, have concluded that it was in the mucilage, because it much more frequently accompanies the saccharine matter. These, misled by the presence of tartar in wine, have supposed they had discovered in it the real ferment; if they had not confined their observations to the juice of the grape, if they had considered that of other juices in which the existence of that salt cannot be demonstrated by analysis, they would not have fallen into that error. Those, again, inconsiderately adopting every opinion, have asserted, that the mixture of these different matters presided, as it were, over fermentation, effected the decomposition of the sugar, and its conversion into alkohol*. Of these hypotheses, some are evidently

* When I read this memoir to the Institute, I did not mention the admirable experiments of M. Fabroni on vinous fermentation. I confess I was not then acquainted with them; being still young, I shall, perhaps, appear excusable in the eyes of many, particularly when they are informed that Messrs. Guyton, Fourcroy, Vauquelin, Chaptal, Deyeux, &c. &c. were equal strangers to them, though they had proposed as a prize subject the question which forms the principal object of M. Fabroni's researches. I am now anxious to make amends for this involuntary fault.

M. Fabroni has published two memoirs on vinous fermentation; in the first, which was crowned by the academy of Florence in 1787 or 1788, he attributes this phenomenon to the action of the pure vegetable acid on the sugar; and he adds, that a portion of mucilage and a vegeto-animal matter concur as co-effervescent substances, to produce the expeditious movement in the fermentation of common spirituous liquors. In the second, which he read to the Philomathic Society of Paris, when he came to France to assist in that great design the uniformity of weights and measures, he thus expresses himself: "vinous fermentation is the re-action upon the sugar of a vegeto-animal substance (gluten), which Becchari has discovered in flour."

Some have thought that there is a great resemblance between my paper and M. Fabroni's; and can, perhaps, scarcely believe that I was unacquainted with the latter. On this subject I can appeal to the testimony

dently false; others are plausible, and receive from a specious reasoning some degree of probability. But, before

mony of Messrs. Fourcroy, and Vauquelin, to whom I communicated my researches before I presented them to the Institute: But I will add a still more decisive proof. The second memoir of M. Fabroni, was printed only in the form of an extract, for which we are indebted to M. Fourcroy. If I had been acquainted with it, should I have read him mine, without mentioning that of the learned chemist of Florence? It may then be asked, how it happened that M. Fourcroy should so completely forget a memoir with which he was perfectly well acquainted; and, particularly, how it was possible for the perusal of another, on the same subject, not to remind him of it. This I know not; but such is the fact. But I suspect, that as it contained only the above-mentioned sentence that refers to the phenomenon of fermentation, and as the author produced no experiment in support of his opinion, this memoir was the less striking, and might have been forgotten in the lapse of time. Supposing, however, that I had been acquainted with M. Fabroni's researches, it is easy to discover that I should not have been able to derive any kind of advantage from them; for I should have begun by repeating his experiments; and should, consequently, have mixed well-washed gluten with sugar and water. On the contrary, the gluten, which M. Fabroni considers as the fermentable principle, has no action upon sugar. (M. Fabroni, without doubt, did not wash his gluten sufficiently, and in that case it is capable of making sugar ferment. We shall presently see the reason of this.) The consequence which I should have drawn from this experiment is evident. Probably, instead of gluten, I should then have mixed a certain quantity of sediment with the sugar and water. (M. Fabroni applies the term, *sediment*, to that matter which disturbs the juice of grapes, and this matter, according to him, is the same as gluten, and by its re-action upon the sugar converts it into alkohol and carbonic acid.) But this sediment, when well-washed, produces no alteration in sugar.

I mean not to assert that the sediment obtained by M. Fabroni did not, with the sugar, produce spirituous fermentation. The grapes which he employed were of a different nature from those which I used; and, on this account, our results may differ. Hence it is obvious, and that is what I wanted to prove, that I had no knowledge of M. Fabroni's

before they are admitted, experience ought to be consulted; without considering any, we ought to derive from observation that theory which is too often previously created. If the genius of Staahl, instead of broaching the system of phlogiston, a substance which never existed but in the brilliant imagination of that extraordinary man, had exerted itself more than it did in developing nature by means of experiments, Staahl would perhaps not have erred; Staahl would probably have discovered the truth, and would have deprived France of the glory of having given birth to the author of the modern theory. Such is the course I have followed; before I formed or adopted any system, I observed the facts, and drew from them such consequences as, I think, ought to lead to the knowledge of what passes in liquors during fermentation. But in such a delicate matter nothing is more easy than to be mistaken; and it is principally to correct my ideas, if they be not just, that I am about to submit to the class the result of my researches.

I made my first observations on the juice of gooseberries. I had powerful reasons for preferring that to any other; its fermentation is the most expeditious, and

broni's researches, before I made similar ones; that the acquaintance with his researches, though of great utility to science, would have been of no advantage to me; and, finally, that there exists a remarkable difference between M. Fabroni's opinion and mine, on fermentation. M. Fabroni attributes it to the re-action of the gluten on the sugar; I prove that it is not owing to the gluten, but to a distinct matter. Besides, M. Fabroni's observations are confined to the juice of the grape; I have examined the question generally; I have considered the juices of all fruits. M. Fabroni imagines, that all the carbonic acid which is disengaged in fermentation proceeds from the carbon of the ferment which seizes upon the oxygen of the sugar; and I demonstrate that $\frac{4}{5}$, at least, proceed from the sugar.

consequently

consequently it is the most proper for elucidating the causes which produce it. All my researches at first tended to discover the matter which serves as a ferment. This, I conceived, would be a great step towards resolving the problem, or at least towards developing a multitude of truths that were still unknown, if I could determine its nature, ascertain whether it is always the same, or whether there are several kinds of matter possessing the same property. This very important question had long struck me; it had frequently occupied my attention, and I entertained the idea of attempting its solution, when the Institute proposed it as the subject of a prize. This was a powerful additional motive with me to turn my thoughts to it. I was by no means inclined to admit several fermentable principles; every thing led me to believe that there was only one, and that this was none of those hitherto imagined, because, in fact, neither extractive matter, mucilage, nor tartar, &c. act upon sugar. But this required a positive demonstration, and though I have not yet obtained proofs perfectly satisfactory on this head, yet as there is no proof of the existence of several kinds, and it appears every where the same, that opinion seems to me to deserve the preference.

I strained, through a fine linen cloth, the juice of a kilogramme of gooseberries; it was thick, and held suspended a matter slightly glutinous, which I separated with the filtre, and washed in a great quantity of water. As nothing ought to be disregarded in those sciences that depend upon observation, I submitted this matter to a regular examination. My first care was to put it, together with some sugar, into water, to see whether it was capable of producing fermentation; I observed that several bubbles of an elastic fluid were soon disengaged, which

[redacted]

which I ascertained to be carbonic acid. The effervescence lasted eight days, and, at the expiration of that time, the liquor, which was very pleasant, had only a slightly saccharine taste; it contained a great quantity of alkohol, and so perfectly resembled a wine not quite made, that it might have been mistaken for it. It may well be supposed that I redoubled my zeal and attention in the examination of a substance which presented me what I was seeking; it was natural that I should first see whether the whole were capable of decomposing sugar. As less than a sixth part of its weight was able to effect this decomposition, I thence concluded that it contained, only in a small quantity, the fermentable principle, which I endeavoured, by every imaginable method, to separate from it, and to obtain by itself, but in vain. All that I could do, after this, was to examine it comparatively before and after it had been employed for fermentation. This substance, however, did not appear to be altered by fermentation, it continued insipid, insoluble in water and alkohol, without any power over tincture of turnsol, or syrup of violets; but, when distilled, it afforded no trace of volatile alkali. This result, which did not surprise me, being confirmed by a second experiment, was, however, a ray of light that encouraged me to pursue the path I was following; it shewed me that the germ of fermentation was of animal nature; it agreed with the ideas I had conceived, and imparted to my suspicions an appearance of reality.

TO BE CONCLUDED IN OUR NEXT.

Improved Method of preparing Liquid Ammoniac.

From Göttling's Pocket-Book for Chemists and Apothecaries for the Year 1803.

THE preparation of water impregnated with ammoniac, or liquid ammoniac, may be improved with respect to the proportion of the materials from which it is obtained, and the form of the apparatus in which the process is performed.

It is evident, that in the first point an improvement is still to be desired, if we consider that notwithstanding the diminution in the quantity of lime to be mixed with the sal ammoniac, already made of late years, the quantity of that article, which renders the operation extremely difficult, is still much too great; for the usual proportions are 1½ part of lime to 1 part of sal ammoniac. Upon comparing the proportional affinity of the constituent principles of this salt with that of the principles of muriate of lime, we obtain the following results: 100 parts of sublimated muriate of ammoniac contain 69 parts of ammoniac and water, and 31 parts of muriatic acid. To saturate these 31 parts of acid, and to set the ammoniac at liberty, 44 parts of pure lime are necessary; which, with 31 parts of acid and 25 of water, compose, according to Bergman, 100 parts of muriate of lime. According to this statement, 16 parts of muriate of ammoniac, containing about 5⅓ ounces of muriatic acid, would not require quite 7½ parts of lime; but as common lime is not pure, and contains a small quantity of clay, iron, and silica, that proportion ought to be augmented. According to my experiments, 12 parts of lime are sufficient to decompose 16 parts of sal ammoniac, and, by taking equal

equal parts of those two substances, no other risk is incurred excepting that part of the sal-ammoniac may remain undecomposed.

With regard to the kind of apparatus to be employed, improvements still remain to be made, as will be readily acknowledged by all those who have once prepared liquid ammoniac.

We know that ammoniac is so volatile, that when distilled with water it first passes over in the form of gas, and endangers the breaking of the retort, especially if every vent be closed; and by leaving a vent, the quantity of ammoniac which passes over before the vaporisation of the water is lost.

This danger, it was conceived, would be avoided by putting water in the recipient, or by operating with Woulfe's apparatus. These methods are either not very practicable, or not the most advantageous to the apothecary. The first is not practicable, for this reason, because, by merely putting water into the apparatus without plunging into it the neck of the retort, the contact of the ammoniacal gas with that liquid is not sufficiently close to condense the gas as fast as it is disengaged: the second is neither practicable nor advantageous, because the arrangement of Woulfe's apparatus is not only extremely troublesome, but the apparatus itself is too expensive for common operations.

In the following process, these several inconveniences are corrected.

Slake 16 ounces of lime, well burned, with a sufficient quantity of water to make it into a liquid paste. Put this paste into a stone or glass retort, add 16 ounces of pulverized sal ammoniac, and cover the mattrass with a cap, to which must be adjusted a tube, of sufficient length to reach to the bottom of the recipient. Mark

 on

on the recipient the height to which, when it is adapted to the mattrass, 48 ounces of water would rise; put in it the half of that quantity of water, and fasten it to the cap. Then lute all the interstices with paste, made of flour and gypsum, and proceed to distillation in the usual manner. The extremity of the tube being plunged into the water, the ammoniacal gas is immediately absorbed, and the operator need not be under any apprehension either of bursting the vessels, or of sustaining the smallest loss of ammoniacal gas. In this operation we know that the condensation of the gas heats the liquid. Continue the distillation till the liquid has reached the point marked. Thus, without the least danger to the vessels, or any loss of the material, 48 ounces of highly saturated spirit of sal ammoniac are obtained.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Composition for covering the Stems of Trees.

MR. Forsyth in a postscript to a new edition of his work on fruit-trees, which will shortly be published, inserts a letter, signed by several medical gentlemen of eminence, confirming the efficacy of his process for renovating trees. He also mentions a discovery which he has recently made, and which, as being calculated to save time and labour, may deserve attention. Instead of paring away the bark, as had heretofore been the practice, and covering the stem with the composition, he now merely scrapes off the loose bark, and applies a mixture of cow-dung and urine only, (made to the consistence of a thick

paint),

paint), with a painter's brush; covering the stem carefully over. This softens the old scabrous bark, which peels off during the following winter and spring, and is succeeded by a fine smooth new bark.

Threshing-Mill.

Messrs. Edes and Nicholls, of Elm, in the Isle of Ely, have had a threshing-mill built, by Mr. Wigfull, of Lynn; which they have used for three seasons. It was made for four horses, but altered for six. It cost 100 guineas; threshes with ease fifteen to twenty quarters of wheat, twenty-five to thirty-five of oats in a day, and would do more; requires two women, three boys, and two men. It performs its work with every sort of grain, so much to their satisfaction, that they are now building a second at another farm; and is so far superior to the flail, that trying the straw of two men's threshing in a day and a half, one bushel of clean wheat was gained.

Parsnips.

The Earl of Romney tried an acre of parsnips at the Mote, and his success was such, as to give him reason to think the culture highly profitable. He gave them to his cows, and these yielded milk in uncommon quantity, and better than any other food he has tried; the cows were as eager for this food as for oil-cake.

Hemp.

Mr. Leeds, of Somersham, in Huntingdonshire, upon a black peaty soil, made-land, having been the bed of an old river, much over-run with nettles and other rubbish, sowed hemp on six acres three roods; he got two last and one half of seed, without taking the advantage of picking the femble hemp; after threshing he stacked it, and in the spring watered and dressed it. Produced 350 stone, or above 50 *per* acre. It cleaned the land completely.

Manures.

Manures.

Mr. Thompson, at Waverley-Abbey, in Surrey, has used graves from the London tallow-chandlers, with very great success on a sandy soil: 10 cwt. *per* acre, at 8*s.* *per* cwt. have had this year an effect for turnips, that is extraordinary. Laid on the poorest part of a field, they have pushed forward the crop beyond the best soil in it; and rendered it so very superior, that probably no common dressing of the richest dung would have exceeded, nor any common manure equalled it. They were tried on two fields, and the effect the same in both.

Lord Mulgrave's Premiums.

On the 3d of October Lord Mulgrave distributed his annual premiums among his tenants and cottagers. The rewards to the tenants for the best management in different branches of husbandry consisted of silver cups and medals of different value. The rewards to the cottagers were substantial, and to them of great value.

The cottager who had brought up the greatest number of children, and given them a religious and useful education, without any parochial relief, received a good milch cow; the second most deserving cottager, under the same regulations, obtained a milch cow also; and the third a suit of clothes. As his lordship has given gardens to his cottagers, rewards were given to those who had their gardens in the best condition, and had rendered them most productive in useful vegetables. Though this is only the second year, the advantages of this institution are already visible on his lordship's estate, from the happy spirit of emulation it excites in every farmer and cottager.

Preventive

Preventive of the Plague.

Dr. J. de Carro, of Vienna, in a letter to Dr. C. Haug, of Rastadt, has communicated a new discovery made by Dr. Lafond, of Salonica, in Macedonia, and Dr. Aubon, of Constantinople, that vaccination is a preservative against the plague.—The experiments of Dr. Aubon prove that of 6,000 persons inoculated with the vaccine at Constantinople, not one of them was attacked by the plague; that children subjected to the vaccine inoculation were made to suck mothers attacked by the plague, without any of them being infected; that an Italian physician, who devoted himself in Turkey to the study of the plague, being fully convinced of the property which the vaccine has of preserving from this malady, took every opportunity of coming into contact with persons infected by the plague. The vaccine pustules have been found on the teats of the cows, and the hands of them who milk them, in the villages round Constantinople. When an inhabitant of these villages has been infected with the plague in distant countries, and returns with that malady, he has either died or been cured without the disorder spreading: in the last place, the confidence of several classes of men, and chiefly of the Armenians, in the preventive quality of the vaccine against the plague, is so great, that a number of people are inoculated every year with it to preserve them from this malady.

Method of giving to Malt-Spirit the Flavour of Brandy.

In a late number of the Bibliothéque Physico-Economique is inserted the following method of giving to malt-spirit the flavour of brandy. Into two quarts of malt-spirit put three ounces and a half of powdered charcoal and

and four ounces and a half of ground rice. Let these ingredients remain about 15 days, taking care to agitate them frequently during that time; filter the liquor, and its flavour will be found very much improved.

Wool of New South Wales.

A specimen of wool has been brought from New South Wales, which is deemed superior in softness, and in every other respect equal to the best Spanish wool, and worth about six shillings *per* pound. The sheep producing it were originally sent from Spain to the Cape of Good Hope, and thence to Port Jackson. Captain M'Arthur, who has devoted much attention to improve his flock in this colony has now about 4,000 sheep with Spanish rams: he calculates, that with proper care the number will double itself every two years and a half; and that in twenty years his stock will be so much increased as to produce a quantity of fine wool, equal to that now imported from Spain and other countries at an annual expence of 1,800,000 *l.* sterling.

List of Patents for Inventions, &c.

(Continued from Vol. III. Page 480.)

ROBERT ATKINS, of Fenchurch-street, in the city of London, Mathematical Instrument-maker; for improvements in the construction of hydrometers, for ascertaining the strength of spirituous liquors; and a sliding rule of correction for temperature to the hydrometer, and various improvements thereof.
Dated October 31, 1803.

EDWARD THOMASON, of Birmingham, in the county of Warwick, Button and Toy-manufacturer; for a new mode of making hearth brushes.
Dated October 31, 1803.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XX. SECOND SERIES. Jan. 1, 1804.

Specification of the Patent granted to JOSEPH HUDDART, *of Islington, in the County of Middlesex, Gentleman; for a new Mode or Art of making great Cables, and other Cordage, so as to attain a greater Degree of Strength therein, by a more equal Distribution of the Strain upon the Yarns.* Dated April 25, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Joseph Huddart, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, and declare that the plan thereof hereto annexed (see Plate IV.) is composed of the following particulars; that is to say: No. I, a spindle and bobbin, in which A B represents the spindle; C D, the bobbin (with the yarn upon it from *c* to D); E F, the axis which carries the spindle; *a* G H an arm of wood, fixed upon the square part of the spindle, and which goes round with it (part of which G H may be of wire) with a

hole at H, or a friction wheel or pully to receive the rope-yarn, which from thence is to be led through a hole in the end of the spindle at B. At K a spring is fixed to the wooden arm by means of a screw and nails, or otherwise. The screw works in the square part of the spindle by means of which the spring may be made stronger or weaker as requisite, the other end of which resting upon the globular part of the head of the bobbin formed for that purpose, to regulate the tension of the yarn in drawing it from the bobbin, whilst the spindle is turning in registering the strand. This spindle and bobbin is carried by the axis E F. The smaller end of the spiddle A is square or triangular, and fits into the end of the axis at E; which axis is carried by a band going round the pully (or pinion if carried by a wheel with teeth) at *e f*. The spindle and bobbin is easily shifted by lifting the end at B out of the notch which it runs in, and drawing it out of the axis at E.

No. II, another spindle and bobbin, in which I, L, M, N, O, K, represents a spindle, continued into a square frame of iron, to revolve round upon the pivots I, K. The pivot at I is perforated, in order to receive the rope-yarn from the bobbin, which runs at a right angle to I K upon the spindle or axis P Q. This bobbin is adjusted by a screw in the same manner as the first-mentioned, or by two springs and screws *x* and *y*, one at the head P and the other at Q, having two globular, or nearly parallel, parts at each end of the bobbin for that purpose. The bobbin is soon shifted by taking out the spindle P Q, which is done by shoving it towards P against the spring *p* P, till the end of Q in the square frame is relieved; the spring *p* P is to keep the spindle in its place, while the whole is carried round upon the pivots I, K, by tooth and pinion, or band, round the pully R S, and at the same time supplies the

the yarn as before mentioned, whilst the strand is registering.

Nos. III, the machine which carries the spindles in horizontal ranges, and ought to be constructed according to the size of the largest ropes the manufacturer has occasion to make. Fig. 1, represents an elevation or section, whose plane is perpendicular to the axis and spindles; and the circles projected thereon are the large end of the bobbins, which are placed in horizontal ranges, each range supported upon the horizontal railing, and rise higher from the front towards the back part of the machine.—No. III, Fig. 2, represents a profile or section parallel to the axis of the spindles, and perpendicular to the horizon.—No. III, Fig. 3, the horizontal plane, which is also parallel to the axis of the spindles. In these three figures the same letters are used in each, to denote the same part of the machinery: the number of spindles to be employed in this machinery may be increased or diminished, as occasion may require. The base of this machine consists of three pieces of timber to lay upon the ground or near it, marked A in Fig. 1, and A *a* in Figs. 2 and 3; and at right angles to these are bolted two pieces B *b* over the ends of the former, and a third may be added endwise between if necessary, to secure the whole, and must extend over the piece A *a* on one side a convenient length, to receive the pillars, which support the long axis Fig. 3; which long axis, when turned by the handle G, gives motion to all the spindles by the communication of a band to every range of spindles. In this machine there is allowed one foot of room for diameter of the bobbin, and eighteen inches for the length of the spindle marked *y*: the spindles are carried by an axis marked *x*, (as represented in spindle and bobbin, No. I,) and will therefore require three rails

 or

or ranges of boards for each range of spindles, two of which support the pivots of the axis *x*, and are marked D *d*, No. III, Fig. 1, and the third, the front end of the spindle, in which there is a notch to drop the spindle into when the bobbin is shifted. Those are supported by the pillars E, *e*, No. III, Fig. 2. Each range is fixed higher than the one before it; and it is also necessary to have a rail F for each range, to lead the yarns clear of the foremost bobbins, which rail has a notch cut in it for each yarn to lead through.—Upon the long axis, which is carried by the handle G, are as many pullies as there are ranges of spindles. In this drawing they are seven in number, and are marked K; the band going round these pullies passes over the friction wheel H, and thence round every pully in that particular range, and over the friction wheel *h*, and returns again into itself at the pully K, which, with the pullies upon that range, must be equal in diameter, in order that one turn of the handle may give one turn to each spindle; and the same must be attended to in every range. The machinery for the spindle and bobbin No. II, differs from that of No. I, in this respect only, that it is necessary to allow more room in the breadth for each bobbin, and consequently there will be fewer bobbins in each range when the breadth of the machine is the same. The machine will require but two rails to support the spindles, as they require no separate axis to carry them, the pully being fast to the spindle, and always remaining in the machine, for the small iron rod only (which the bobbin runs upon) is taken out to shift the bobbin. In these machines there is a space left between the first and second, the third and fifth, and the sixth and seventh ranges of spindles, as marked M, in No. III, Figs. 2 and 3, to allow a person to pass between, and shift or replace any particular

particular bobbin that may have the yarn expended. And it is also to be observed, that those machines may have the spindles carried by wheels and pinions, instead of bands and pullies, if required. I have represented in No. III, Fig. 2, the yarn from each of the seven ranges of spindles passing over the rail F, and from thence to the posts marked L, in which there are as many rails as ranges of spindles. There are cleats upon each post to support the rails, and each rail has as many notches in the upper side as there are spindles in a range. I have represented one of those rails, No. III, Fig. 3, and the yarns leading from the front range of spindles. This railing may be either in the middle of the ground or carried along one side, as in No. III, Fig. 3; the distances between them such as may be thought necessary for supporting the yarns, and keeping them separate the whole length of the strand, and may be made of various constructions.

No. VII. rails (*a*), which will be intelligible upon inspection of the drawing, where B *b* represents the rails.

The register is calculated to form the strand into shells of yarns, and therefore they must be made of different sizes, and with more or fewer holes, according to the intended size of the cable or rope. In the drawing No IV, the front, A *a*, B *b*, made of wood, is perforated with circular ranges of holes, which may be about two inches asunder, through which all the yarns in the strand are to pass, and this brings them into a proper form to go through a smaller and similar plate D *d*, having in it as many holes, as A *a*, B *b*. This plate may be made of wood or metal, the plane of the front of which must be parallel to A *a*, B *b*, and fastened to it by three or four bars of wood or iron; the holes in D *d* must be so near together at the side next F as only just to free them clear

clear of each other, and if made of wood, bored diagonally, to extend farther asunder towards A *a*, B *b*, except the centre hole, which must be perpendicular to the centre hole in A *a*, B *b*. This disposition of the yarns is necessary previous to their passing through the cylindrical tube of metal, in which the strand is compressed and formed. This tube compressing the yarns, and confining the outer shell to its proper figure, which outer shell compresses the next, and so on to the centre, there cannot be any crossing of yarns or change in situation, but the whole strand formed close and compact, and no more yarn required from the bobbins than is necessary, according to the situation of the shells, or their distance from the centre. The tube is made in two parts longitudinally of thin steel of a spring temper, marked F, (No. IV.) and is secured to D *d* by a plate of metal G *g*, and three or four bars or rods, with screws to adjust it, and give it the best position. The cylinder has a projection at the fore end, which is larger than a hole in G *g*, to receive the tube, and therefore brings it forward in registering the strand, and the plate G *g* is also made in two parts, by which means both the plate and the tube may be taken from the strand, and applied to it again, or repaired, if it should happen to be broken during the operation; each part of the tube marked F is more than a semicircle of the size of the strand which is to be registered, in order that the thin edges may overlay each other, and being a spring temper, is compressible by a wire or thong going round it several times, and fastened to the jaws of a heaver, marked No. VI, E E, *f f*, in which E E represent the jaws to which the thong or wire is made fast, and move between the cheeks upon the bolt at H, which may be set farther asunder by shifting the bolt at H so as to have the handles *f*, *f*, at a proper distance

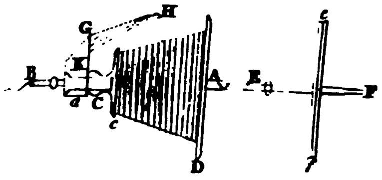
tance for the man who registers to lay hold of, and by this heaver compressing the tube by a constant force, the tube will expand or contract, in case the general run of the yarns be thicker or smaller in different parts of the strand, and will form, as was said before, a compact strand, and free from hollows, which might otherwise be occasioned by crossing of yarns over each other.

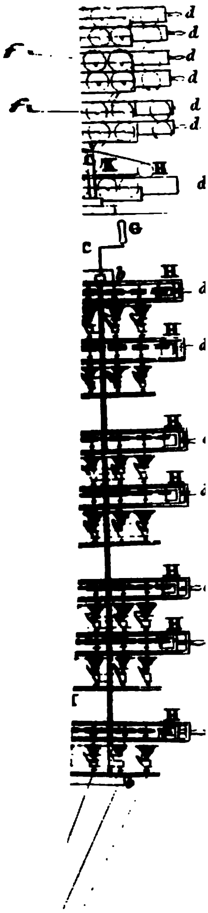
No. V. *Register Gauge* is as follows. A B, is the stock or thick part of the gauge, in which there is a groove or slit for the tongue or index D *d* to move in; upon the centre *i*, on the side *d*, is fixed to the stock A B a semicircle, upon which are two graduated arcs of circles concentric with *i*, one of which is marked L, *(laying,)* the other R, *(registering)*; those two arcs are graduated, answering to the mean stretching of the yarns founded upon experiments. To use it, the stock of the gauge must be applied to the side of the strand parallel to the axis, and the tongue to lay over parallel to that part of the shell of outside yarns where it touches the strand, which shews the angle made by the outside shell of yarns; and a line on the surface parallel to the centre of the strand, and the corresponding graduation must be used in registering, and when the strands are laid into a rope.

Having described the various parts of the machinery and implements to be used, I shall now enter upon the operation. The bobbins being all wound full of yarn, (which may be done by a machine to fix them upon with a handle to it,) and put upon the spindles, and the ends of the yarns led through the holes H, and ends of the spindle B, No. I. The end of the spindle A, is put into the end E of the axis, (which always remains ready for use,) and the fore end of the spindle B dropped into the notch in the rail; then draw off some yarn, and regulate the

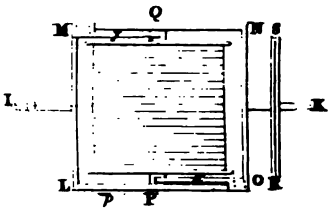
the springs, if wanted, till of equal force, and sufficiently tight.—Then draw off the yarns, leaving the yarn from the bobbin long enough to reach the fore part of the machine where it is to be knotted to the yarns of the strand having fixed as many bobbins as intended yarns in the strand, or in the three strands, if the machine will carry so many, for though I shall only speak of registering one strand, yet the three strands may be registered all at the same time; the bands (if bands are used and not wheel-work) should also be made tight to carry the axis, which is done by a screw, *d*, adjusting the friction-wheel H. The strand is then to be run and laid upon the rails or supporters, each yarn in its proper notch, and for expedition, one of the rails may be used for separating the yarns, and laying them in the rails, dropping a whole range into the notches at once, which being done, the yarns of the strand are to be smooth knotted to the respective yarns from the bobbins, and the machine is ready for use. The yarns at the other end of the strand are then to be put through the register, taking off the tube and plate, if not already done; it is best to take the centre yarn from the railing, (or middle yarn of the middle rail,) which put through the centre hole of the register, and then select the yarns from the railing, to lead clear of each other when stretched to the holes in the register. The holes in the register being completed with yarns, let the ends be collected together upon a stretch, and made fast to the hook which turns the strand in registering, and slide the register back near to the hook, if not so before; then put on the tube and plate, and adjust it by the screws when upon the strand. Lastly, put round the tube the thong or wire, and make it fast to the jaws of the heaver, and heave it tight. If the handles of the heaver are too near or too far from each other, for

N° I.

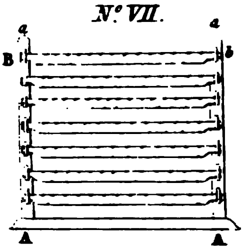




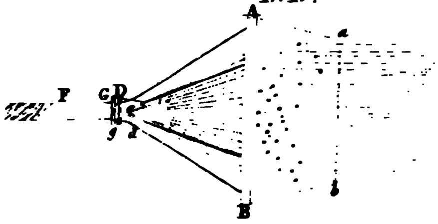
N° II.



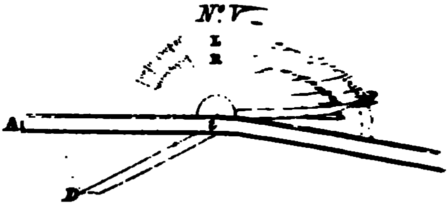
N° VII.



N° IV.



N° V.



for the convenience of the man that registers the strand, alter the bolt till it is right, and all is ready to begin to register the strand. The foreman having determined how hard he will lay the rope, suppose No. 10, in the register gauge, fix index *d* of the gauge to 10 on the arc R, and taking a few turns with the hook, keeping the heaver tight to compress the tube, try the gauge, and regulate the registering according as it is found to vary, till the outside yarns correspond with the tongue D of the gauge, and make the required angle, and which may be repeated as often as it is thought necessary through the registering of the strand. If the three strands are registering together, it must be a triple register in one frame, and there is no necessity to try but one strand with the gauge, if the yarns are of the same kind. The three strands (or four, if a four strand rope) being registered, must be made fast to the hooks in the common way equally tight. For laying, the index of the gauge being altered from 10 on the arc R to 10 on the arc L, or whatever the number was intended to be, the corresponding numbers must be used, then turning the hooks of the strands till the outside shell of yarns correspond with the tongue of the gauge, and begin to lay the rope. It is to be understood, that in registering, a sufficient weight is laid upon the hook to prevent its being drawn towards the machine.

In witness whereof, &c.

Specification of the Patent granted to DANIEL PAULIN DAVIS, *of Bloomsbury-square, in the Parish of Saint George, Bloomsbury, in the County of Middlesex, Surveyor; for an improved Machine for, and Method of, cleansing and sweeping Chimneys, and extinguishing them when on Fire, which will supersede the Necessity of their being explored by Children as now practised.*

Dated April 11, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Daniel Paulin Davis do hereby declare, that my said invention of machines or apparatus for cleansing chimneys, and extinguishing them when on fire, hoping thereby to supersede the necessity of that business being performed by children as is at present generally practised; the particulars and explanation to the respective parts, collectively as well as individually, of each and every part of the said machine or machines, or apparatus, are as follows: A swinging or fixed bar or roller, as the case may require, is to be fixed at the top, or thereabouts, of the funnel or flue of the chimney, in an horizontal direction, from side to side, over which a chain or rope, formed of metal, or other materials proper for the purpose, is to be suspended, and sufficiently long to reach below the mouth or mouths of each chimney, where an expanding or flexible brush or brushes, composed of hair, cane, willow, birch, or other proper materials, is to be hooked, or otherwise fastened to the said chain, wire, or rope, as occasion may require, or when wanting for use, and taking off when the flue or chimney is sufficiently swept or cleansed. And in order to do that the more effectually, a roller or bar is to be fixed from

the

the inside of the breast to the back, at a sufficient distance from the jamb on each side the mouth or throat of the chimney. A few inches above the chimney-bar, or mantle, over which the chain, wire, or rope, or projecting wings of the flues will not escape being swept, as well in the channel of the flues as the mouth or throat of the same, some of which run in a zigzag or crooked direction, so as to leave the points of the gathering wings with a sharp edge; and therefore to prevent the brush or brushes, chain, wire, or rope, from meeting with any effective impediment in its passage from the mouth or throat of the chimney to the top of the channel of the said flues in passing up or down, some small balls of cork will be hung on various parts of the said chain, wire, or rope, to become moveable whenever it meets with the smallest interruption in its passage, as before described. And, to prevent the necessity of any person or persons going withinside the mouth of the chimney, for the purpose of drawing up or down the brush or brushes before named, as well as to keep the soot withinside when falling by being so disturbed, I have formed an apron or cloth to be hung against the opening of the chimney, with two arm-holes therein, through which the hands or the arms of the person so employed are to be placed; by which the brush and chain, wire, or rope, can be drawn up and down without being exposed to the soot when falling or receiving it into the room or works. And after the business is so performed, either the same chain, wire, or cord, may be left in the chimney, across the bar, or some other hauled by the end into its place, and the ends thereof fastened within reach of the hand. And in case a flue or chimney should be on fire, wherein the aforesaid machine or apparatus is contained, I have formed a bag or parcel of wadding, which by being

wetted and hung on the chain or rope in lieu of the brush, to be drawn up and down the flue or channel in the same way as is recommended for cleansing the same. The brush or broom above alluded to may be made in a variety of forms, suitable to the size, shape, or direction of the flues intended to be therewith cleansed. That best calculated for general use is made of balls of wood, or other materials, closely connected to each other by links, yielding to every direction, and adapted to receive, and securely hold, stiff horse-hair, bristles, slender twigs of willow, cane, or strips of whalebone; which brush or broom may easily be drawn over the aforesaid roller, and is indispensibly necessary for cleansing the tops of bevelled and hooded chimneys. In other cases, where it is not requisite to carry it over such roller, another kind of brush or broom, of like materials, may be used, made of four or more moveable sides, supported by, and moving upon, transverse props; which sides may be drawn together at either end by means of lines fixed at the top and bottom of each moveable side, and passing through a ring at each end of the bar, whereon the props are fastened. The sides should be about the same length as the stem or bar to which the drops are fixed; and the props may be set either at the centre of the stem, or nearer to one end, according to the expansion required. I propose also, that the props themselves be made to slide across the bar similar to the slide of a gauge, and to be fastened in any position by a setting screw pressing against their side; and the length of the whole is to be governed by the dimensions of the flue or chimney intended to be swept.

In witness whereof, &c.

Specification

Specification of the Patent granted to THOMAS KENTISH, *of Baker-street North, Portman-square, in the County of Middlesex, Gentleman; for an improved Derrick, for the Purpose of more expeditiously, with less Labour and at less Expense than heretofore, loading and unloading Ships and Vessels, and removing heavy Bodies in any Direction; and which is also applicable to other useful Purposes.* Dated July 29, 1803.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Thomas Kentish do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, by the drawings in the margin of these presents, and as follows; that is to say:

In Fig. 1, (Plate V.) A represents the derrick; B, the purchase wheel; C, the axletree; D, four plates of iron to support the wheel; E, an iron cap for the two plates of D, to fasten with an iron bolt; G, a roller to take the rope of the wheel B; H, the handles; I, four plates of iron to support the roller; K, a break-wheel; L, a lever to press on the wheel K, to lower the weight down. M, a ratched-wheel and paul to stop the roller from going back when hoisting up the weight; O, a ship's mast or a post in the ground on shore, to keep the derrick with a guy; P, the guy; R, a shieve to keep the rope extended; S, a hook to draw the weight; T, the step for the derrick; V, two thwart guys; U, a lever to direct the purchase wheel B and axletree C to keep its level.

TO

To fix the derrick for use on board a ship or other vessel, the step should be secured so near the gunwhale as to allow room for the handles to work, and the head should be secured to the main-yard when stopped up to plumb the step, or to the head of the main-mast, as occasion may require. To fix the derrick for use on shore, a strong oak post of about fifteen inches diameter, more or less, according to the weight to be raised, should be well secured about six feet in the earth with spur-shores. By the derrick thus constructed and fixed, a considerable deal of labour will be saved, and the removal of heavy bodies in any direction very much facilitated.

Fig. 2, the roller, detached, for the purpose of shewing its form and construction, it being different from the roller hitherto used for that purpose.

In witness whereof, &c.

Observations by the Patentee.

The derrick described above has been tried on board a West India ship, and approved. I have now one nearly finished, calculated to hoist up a hogshead of sugar from a ship's hold, twenty-three feet deep, which may be done by three men, equal to eight men, now required at the capstan on-board ship, to deliver a cargo of sugar.

During forty-five years experience in the sea-service, part in his Majesty's navy, and part in the merchant-service, no improvement has been made in the method of loading and unloading ships. I have by study, perseverance, and expense, improved a derrick, which I hope will benefit the public.

By the cranes, both of the old and new invention, there is no difficulty in raising a weight; but I have frequently

quently seen accidents in lowering the lever (when left to unskilful hands) on the break-wheel: the weight has gained so great a velocity, that it could not be checked in time to prevent mischief. The common method of delivering a cargo from ships is by a large luff tackle, fixed to the head of the derrick, the end of the face brought to the capstan, by which four men can with difficulty raise a hogshead of sugar, but it requires five to lower it down with safety; the weight frequently overpowered that number, and obliged them to drop from the bars.

To prevent such accidents, I invented the roller with two inclined planes to my derrick; three turns or more with great weight of rope, from the purchase wheel at the head, are to turn round the centre of the roller, which is taken off as the weight ascends, by a small roller, with two inclined planes, placed a little above the large roller, a man holding or drawing the rope off until the weight is as high as wanted, then the lever is pressed on the break-wheel by a weight at the end, sufficient to check the roller, and make it perfectly easy to the man or boy to ease the rope away as fast or as slow as he pleases. The weight being checked by three powers, the boy holding on the rope, the handle to the roller, and the lever pressing on the brake-wheel.

To place the derrick on board ship, the step must be placed in the centre, on the side of the deck, between the centre of the hatchway and the centre of the craft alongside, the main-yard toped up and secured by about two turns of the topsail-sheet round the main-mast head and main-yard, so that the guy-block for the guy to lead to, and support the head of the derrick, may exactly plumb the step of the derrick on the deck, by which means the weight

weight may either be drawn out of the ship's hold, or out of the craft, without hoisting or lowering the head of the derrick, as the head will plumb both places as required.

The derrick may be applied to various uses on shore, on board his Majesty's ships in ordinary, hospital and prison ships, or to get in the guns and stores of a man of war, by a few hands, before the proper officers and ship's company are ordered on board. The wheel and roller to hoist up water from a deep well, and bring up a large quantity, with less strength and labour than is now required by the common wheel and pinion, hoisting up boats on board men of war or merchant ships to the stern and quarters with more ease and expedition than by the common tackle now used, and lowering them down with safety, as she must go down horizontal into the water, and is disengaged in a moment, which prevents accidents, particularly when the ship has stern way, the boat is often in danger under the counter, before the tackle can be unhooked. Four men will be sufficient to deliver a sugar ship, it now requires eight with the capstan. The derrick gains time, as it will raise a ton weight twenty feet in two minutes, which is very considerably less time than now taken by the capstan. There is likewise a saving in rope; the whole used only weighs three quarters of a hundred, and when condemned for the use of the derrick it will make better lanyards for the top-mast rigging than new rope. The machine with care will last as long as the ship, as it is not liable to get out of repair, and should any accident happen to it, any common mechanic can repair.

Specification

Fig. 1.

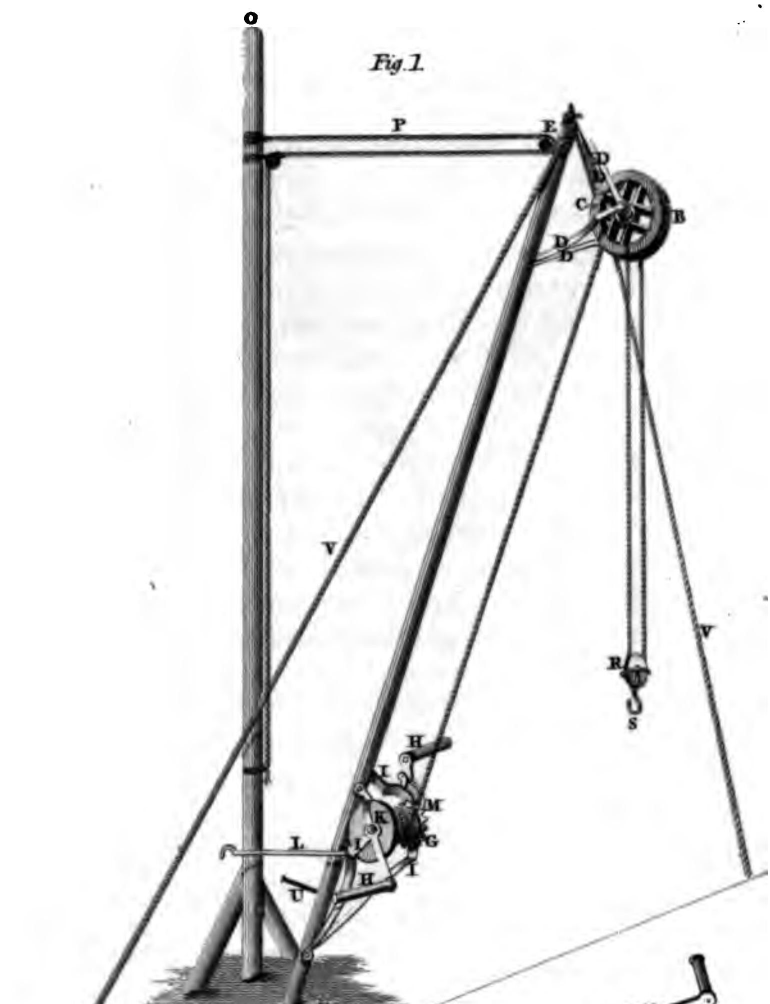


Fig. 2.

Specification of the Patent granted to ROBERT RANSOME, *of Ipswich, in the County of Suffolk, Iron-founder, being one of the People called Quakers; for a Method of making and tempering Cast-Iron Plough-Shares, and other Articles of Cast-Iron for Agricultural Uses.*

Dated September 24, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Robert Ransome do hereby declare that my said invention of a method of making and tempering cast-iron plough-shares, and other articles of cast-iron for agricultural uses, is as follows:

First for the shares.—The melted pig-iron is poured into a mould, prepared for the purpose, formed with one side or part of iron, and the other side or part of sand or loam. The side of the share when cast that lays next the iron-mould will be hard, and of proper temper, while the other side that is formed in sand or loam will be soft; and if made of the best soft pig-iron, the share will be much strengthened.

To make the moulds for casting the said plough-shares I proceed as follows: First, take a well-finished pattern of a plough-share, made either of iron or other metal; then lay it upon sand or loam, carefully stopping it up until an accurate parting is made of that side of the share which is designed to be hardened; then pour thereon either lead, plaster of Paris, or other proper materials, that will take an exact impression therefrom. With this cast of lead, plaster, or other material, I proceed to take a cast in sand or loam of the exact shape, in iron or other metal, which is the part used to form one side of the share, and that gives the hardiness

and temper to the same. The other side of the share is formed in a flask of wood or metal, with sand or loam, in the common way of moulding the same article. These two parts are fastened together by screws, weights, or such other means, as may be used to serve the purpose of confining the moulds together while the metal is pouring therein. The socket (or tray) of the share is formed by an iron or metal plug the shape of said socket or tray being inserted into the mould, by which means the socket is certain of being smooth, and exact in size and shape.

Secondly.—Scarifiers and hoes may be cast in a similar manner to the shares.

N. B. Should it be required to make both sides of the shares, scarifiers, or hoes, hard, and the inner part soft, then both sides of the mould or matrix must be made of iron or other metal.

Any other articles wherein the above described properties are desirable may be made in the same manner.

In witness whereof, &c.

Experiments on extreme Branch-grafting of Fruit-Trees. By WILLIAM FAIRMAN, *Esquire, of Miller's House, near Sittingbourn, in Kent.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was presented to Mr. FAIRMAN *for this Communication.*

FROM much conversation with Mr. Bucknall on the idea of improving standard fruit-trees, we could not but remark that in apple-orchards, even in such as are most valuable,

valuable, some were to be seen that were stinted and barren, which not only occasioned a loss in the production, but made a break in the rows, and spoiled the beauty and uniformity of the plantation.

To bring these trees into an equal state of bearing, size, and appearance, in a short time, is an object of the greatest importance in the system of orcharding, and also for the recovery of old barren trees, which are fallen into decay, not so much from age as from the sorts of their fruits being of the worn-out and deemed nearly lost varieties.

Having long entertained these thoughts, and been by no means inattentive to the accomplishment of the design, I attempted to change their fruits by a new mode of engrafting, and am bold enough to assert, that I have most fortunately succeeded in my experiments; working, if I am to be allowed to say it, from the errors of other practitioners, as also from those of my own habits.

Having many trees of this description, I made an experiment on three of them in March, 1798, each being nearly a hundred years old. They were not decayed in their bodies, and but little in their branches. Two of these were golden-pippins, and the other was a golden-rennet. Each likewise had been past a bearing state for several years. I also followed up the practice on many more the succeeding spring, and that of the last year, to the number of forty at least, in my different plantations *.

I directed the process to be conducted as follows: cut out all the spray wood, and make the tree a perfect skeleton, leaving all the healthy limbs; then clean the branches, and cut the top of each branch off where it

* The average expense I calculated at 2s. 6d. each tree.

would measure in circumference from the size of a shilling to about that of a crown-piece. Some of the branches must of course be taken off where it is a little larger, and some smaller, to preserve the canopy or head of the tree; and it will be necessary to take out the branches which cross others, and observe the arms are left to fork off, so that no considerable opening is to be perceived when you stand under the tree, but that they may represent an uniform head. I must here remark to the practitioner, when he is preparing the tree as I directed, that he should leave the branches sufficiently long to allow of two or three inches to be taken off by the saw, that all the splintered parts may be removed.

The trees being thus prepared, put in one or two grafts at the extremity of each branch; and from this circumstance I wish to have the method called *extreme branch-grafting.*

A cement, hereafter described, must be used instead of clay, and the grafts tied with bass or soft strings. As there was a considerable quantity of moss on the bodies and branches of the trees, I ordered my gardener to scrape it off, which is effectually done when they are in a wet state by a stubbed birch broom. I then ordered him to brush them over with coarse oil, which invigorated the growth of the tree, acted as a manure to the bark, and made it expand very evidently; the old cracks were soon, by this operation, rendered invisible.

All wounds should be perfectly cleaned out, and the medication applied as described in the Orchardist, p. 14. By the beginning of July the bandages were cut, and the shoots from the grafts shortened, to prevent them from blowing out. I must here too observe, that all the shoots or suckers from the tree must enjoy the full liberty of growth till the succeeding spring, when the greater part

[redacted]

part must be taken out, and few but the grafts suffered to remain, except on a branch where the grafts have not taken: in that case, leave one or more of the suckers, which will take a graft the second year, and make good the deficiency. This was the whole of the process *.

By observing what is here stated, it will appear that the tree remains nearly as large when the operation is finished, as it was before the business was undertaken; and this is a most essential circumstance, as no part of the former vegetation is lost, which is in health fit to continue for forming the new tree.

It is worthy of notice, that when the vivifying rays of the sun have caused the sap to flow, these grafts, inducing the fluid through the pores to every part of the tree, will occasion innumerable suckers or scions to start through the bark, which, together with the grafts, give such energy to vegetation, that in the course of the summer the tree will be actually covered over by a thick foliage, which enforces and quickens the due circulation of sap. These, when combined, fully compel the roots to work for the general benefit of the tree.

In these experiments I judged it proper to make choice of grafts from the sorts of fruits which were the most luxuriant in their growth, or any new variety, as described in the 17th and 18th volumes of the Society's Transactions, by which means a greater vigour was excited; and if this observation is attended to, the practitioner will clearly perceive, from the first year's growth, that the grafts would soon starve the suckers which shoot forth be-

* The system succeeds equally well on pear, as also on cherry trees, provided the medication is used to prevent the cherry tree from gumming.

low

low them, if they were suffered to remain*. With a view to accomplish this grand object of improvement, I gave much attention to the general practice of invigorating old trees; and I happily discovered the error of the common mode of engrafting but a short distance from the trunk or body, as in Fig. 1, (Plate VI.) There the circumference of the wounds is as large as to require several grafts which cannot firmly unite and clasp over the stumps, and consequently these wounds lay a foundation for after-decay. If that were not the case, yet it so reduces the size of the tree, that it could not recover its former state in many years, and it is dubious if it ever would; whereas, by the method of extreme grafting, as Fig. 3, the tree will be larger in three or four years than before the operation was performed. For all the large branches remaining, the tree has nothing to make but fruit-bearing wood; and from the beautiful verdure it soon acquires, and the symmetry of the tree, no argument is necessary to enforce the practice.

Fig. 2, was my first experiment about eight years since. The error of No. 1 was there a little amended, and gave me the idea of engrafting at the extremity. Permit me to remark, that those done in my orchards, on the plan of Fig. 2, did not, neither were they able to bear so many apples last season, which was a bearing year, as those on the plan of Fig. 3, which produced me about two bushels, each tree, of the finest fruit I had in my orchards, from the third summer's wood only. Some engrafted with Ribston pippins were beautiful.

Mr. Bucknall visited me this summer, for the express purpose of seeing my trees; and he says the manner of

* This thought should be kept in suspense, as ten years hence it may appear otherwise. However, they will be valuable trees, and highly profitable, as will any other brought under the fame system.

conducting

conducting the system is the happiest that ever was conceived. For when a tree has done its best, and has continued to extreme old-age, just disposed to fall into dissolution, as also when this is the case with trees in a stagnated and barren state, they are thus renovated, and may, with the greatest probability, continue valuable for fifty years to come. I need not say, do not make the attempt when the energy of growth is over; that will easily be seen by the body and arms, but more particularly from the size, figure, shape, and colour of the leaves, which give the proper indication of health or decay in vegetation.

Cement for Engrafting.

One pound of		pitch	To be boiled up together, but not to be used till you can bear your finger in it.
One	ditto	resin	
Half	ditto	beeswax	
Qtr.	ditto	hogslard	
Qtr.	ditto	turpentine	

REFERENCES TO PLATE VI.

Fig. 1, displays the old practice, commonly called Cleft-grafting.

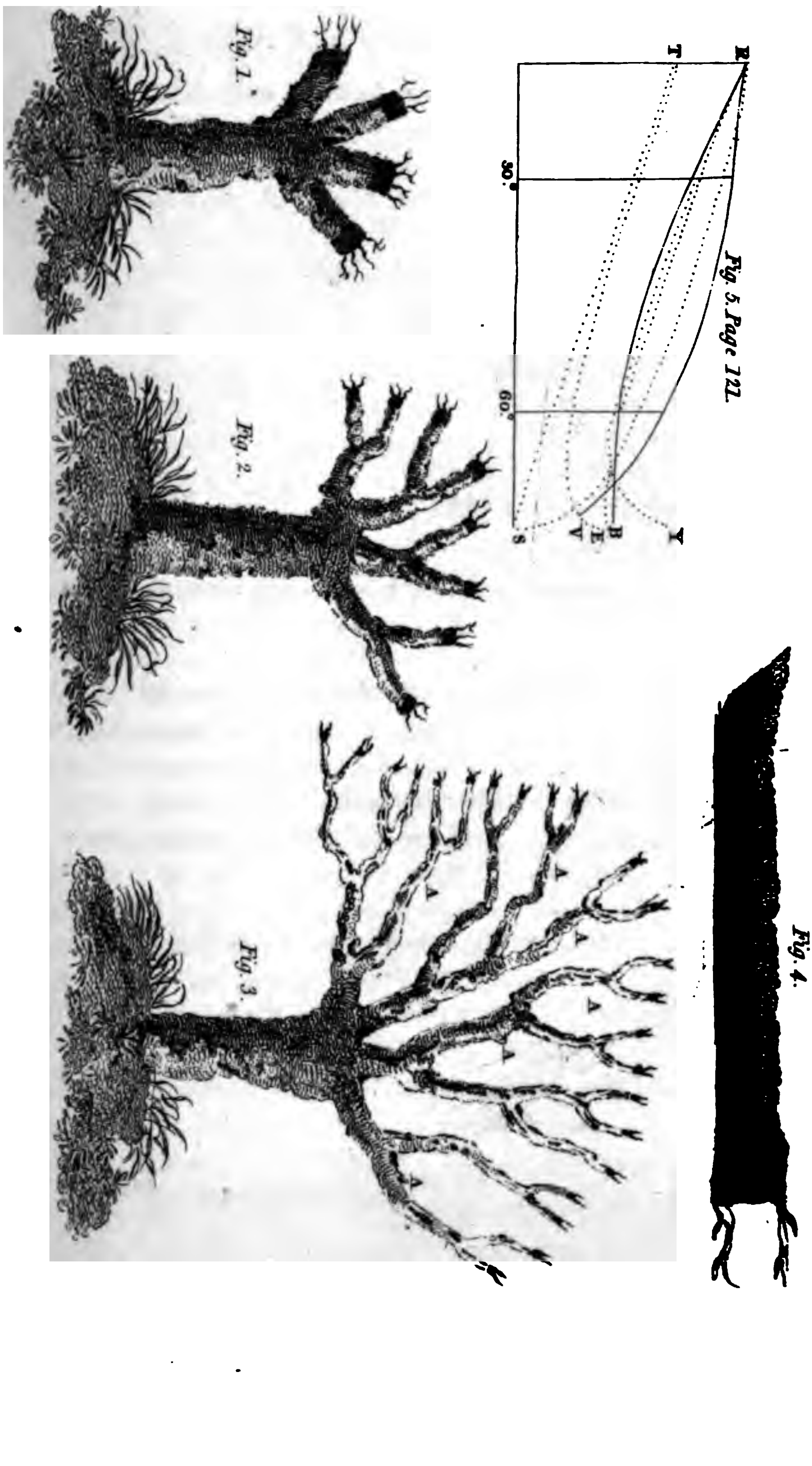
Fig. 2, improved experiment on Fig. 1, by engrafting higher up the tree.

Fig. 3, shews the method of extreme branch-grafting, recommended, from experience, by Mr. Fairman. Two grafts or cyons are there placed at the extremity of each branch; besides which, additional grafts are inserted in the sides of the branches, as at A, or where they are wanted to form the tree into a handsome shape.

Fig. 4, shews, upon a larger scale than the former figures, the method of applying the grafts at the extremity of the branches, and retaining them by the bassmat bandage and cement.

Extract

[redacted]



for use must swim or float an egg, and is called the ley of six degrees of the French hydrometer, or *perseliqueur*. The weaker are afterwards brought to this strength by passing them through fresh barilla; but a certain quantity of the weak, which is of two degrees of the above hydrometer, is reserved for dissolving the oil, the gum, and the salt, which are used in subsequent parts of the process. This ley of two degrees is called the weak barilla liquor; the other is called the strong.

Dissolve the pearl-ashes in ten pails of four gallons each of soft water, and the lime in fourteen pails.

Let all the liquors stand till they become quite clear, and then mix ten pails of each.

Boil the cotton in the mixture five hours, then wash it in running water and dry it.

Step II.—*Bainbic, or Grey Steep.*

Take a sufficient quantity (ten pails) of the strong barilla water in a tub, and dissolve or dilute in it two pails-full of sheeps dung; then pour into it two quart bottles of oil of vitriol, and one pound of gum-arabic, and one pound of sal-ammoniac, both previously dissolved in a sufficient quantity of weak barilla water; and, lastly, twenty-five pounds of olive-oil, which has been previously dissolved, or well mixed with two pails of the weak barilla water.

The materials of this steep being well mixed, tramp or tread down the cotton into it until it is well soaked: let it steep twenty-four hours, then ring it hard, and dry it.

Steep it again twenty-four hours, and again wring and dry it.

Steep it a third time twenty-four hours, after which wring and dry it; and, lastly, wash it well and dry it.

Step III. — *The White Steep.*

This part of the process is precisely the same with the last in every particular, except that the sheeps dung is omitted in the composition of the steep.

Step IV.—*Gall Steep.*

Boil twenty-five pounds of galls, bruised in ten pails of river water, until four or five are boiled away; strain the liquor into a tub, and pour cold water on the galls in the strainer, to wash out of them all their tincture.

As soon as the liquor is become milk-warm, dip your cotton hank by hank, handling it carefully all the time, and let it steep twenty-four hours.

Then ring it carefully and equally, and dry it well without washing.

Step V. — *First Alum Steep.*

Dissolve twenty-five pounds of Roman alum in fourteen pails of warm water, without making it boil; skim the liquor well, and add two pails of strong barilla water, and then let it cool until it be luke-warm.

Dip your cotton, and handle it hank by hank, and let it steep twenty-four hours, wring it equally, and dry it well without washing.

Step VI. — *Second Alum Steep*

Is performed in every particular like the last, but after the cotton is dry steep it six hours in the river, and then wash and dry it.

Step VII. — *Dying Steep.*

The cotton is dyed by about ten pounds at once, for which take about two gallons and a half of ox blood, and mix it in the copper with twenty-eight pails of milk-warm water, and stir it well; then add twenty-five pounds of

madder, and stir all well together. Then having before hand put the ten pounds of cotton on sticks, dip it into the liquor, and move and turn it constantly one hour, during which gradually increase the heat until the liquor begins to boil at the end of the hour. Then sink the cotton, and boil it gently one hour longer, and lastly wash it and dry it.

Take out so much of the boiling liquor, that what remains may produce a milk-warm heat, with the fresh water with which the copper is again filled up, and then proceed to make up a dying liquor, as above, for the next ten pounds of cotton.

Step VIII. — *The Fixing Steep.*

Mix equal parts of the grey-steep liquor and of the white-steep liquor, taking five or six pails of each.— Tread down the cotton into this mixture, and let it steep six hours, then wring it moderately and equally, and dry it without washing.

Step IX. — *Brighton Steep.*

10 lb. of white soap must be dissolved most carefully and completely in sixteen or eighteen pails of warm water; if any little bits of the soap remain undissolved they will make spots in the cotton. Add four pails of strong barilla water, and stir it well. Sink the cotton in this liquor, keeping it down with cross sticks, and cover it up, boil it gently two hours, then wash it and dry it, and it is finished.

Vessels.

The number of vessels necessary for this business is greater in proportion to the extent of the manufactory; but in the smallest work it is necessary to have four coppers, of a round form.

1st. The

1st. The largest, for boiling and for finishing, is twenty-eight inches deep, by thirty-eight or thirty-nine wide in the mouth, and eighteen inches wider in the widest part.

2d. The second for dying is twenty-eight deep, by thirty-two or thirty-four in the mouth.

3d. The third, for the alum steep, is like the second.

4th. The fourth, for boiling the galls, is twenty deep, by twenty-eight wide.

A number of tubs, or larger wooden vessels, are necessary, which must all be of fir, and hooped with wood or with copper.

Iron must not be employed in their construction, not even a nail ; but where nails are necessary, they must be of copper.

By the pail is always understood a wooden vessel, which holds four English gallons, and is hooped with copper.

In some parts of the above process, the strength of the barilla liquor or liquors is determined by telling to what degree a *perseliqueur* or hydrometer sinks in them.

The *perseliqueur* was of French construction. It is similar to the glass hydrometer used by the spirit-dealers in this country ; and any artist who makes these instruments will find no difficulty in constructing one with a scale similar to that employed by M. Papillon, when he is informed of the following circumstances :

1st. The instrument, when plunged in good soft water, such as Edinburgh pipe water, at temperature 60 deg. sinks to the 0, or beginning of the scale, which stands near the top of the stem.

2d. When it is immersed in a saturated solution of common salt, at the same temperature of 60 deg. it sinks to the 26 degree of the scale only, and this falls at some distance from the top of the ball.

This

This saturated solution is made by boiling, in pure water, refined sea or common salt, till no more is dissolved, and by filtering the liquor when cold through blotting paper.

It should also be observed, that whenever directions are given to dry yarn, to prepare it for a succeeding operation, that this drying should be performed with particular care, and more perfectly than our driest weather is in general able to effect. It is done therefore in a room heated by a stove to a great degree.

Appendix to Sir John Sinclair's *Essay regarding Cattle.*

(See our last Number, Page 36.)

On the different Kinds of Cattle Farms.

Cattle farms may be classed under the following heads: 1. Breeding farms. 2. Dairy farms. 3. Grazing farms. 4. Suckling farms. And, 5, farms where cattle are worked. A few cursory observations on each, is all that the limits of this paper will admit of.

I. *Breeding Farms.*—In breeding cattle, it is proper (if the size of the farm will permit the rule being observed) to separate the different ages, and to graze them, as much as possible, in distinct pastures; as the older ones have a jealousy of the younger, driving them from the best grass, and sometimes doing them a material injury.

Bulls will in general retain their vigour till they are twelve or fourteen years old, and there are instances of their being kept till they are even nineteen years, but they are certainly in their prime from three to six. They ought

ought to be kept in one field, which prevents their rambling; and the cows should be brought to them. But it is still a better plan to work the bulls with the oxen, as the owner has thereby the profit of their labour, and all risk of their doing mischief is prevented.

Mr. Bakewell used to put off sending his heifers to the bull till three years old, but his cows often missed calf, which might be owing to that circumstance. It is better, therefore, to send them to the bull at two years old, and some recommend strongly even an earlier period *. In the northern counties, they wish their cows to calve when the grass is abundant. This, it is supposed, opens their milk vessels, and is a great means of rendering them ever after good milchers; which is not the case, unless nature is early made to have a tendency to that species of secretion. It has been found a good plan to give the whole of the milk a young cow yields to the calf, which she readily does, and thus gets into a good habit of milking.

Bull calves † are generally nursed by the mother, but sometimes by hand. It is said that Mr. Bakewell had two nurses for some of his favourite stock. On the other hand, in the north of England, where rearing a number of cattle is the object, they sometimes put two calves to one cow. Hay-tea ‡ is sometimes given them, and eggs in

* It is said that young cows, as early as even one year old, might be sent to the bull. If this would not stint their growth, (which good feeding might obviate,) it might be adopted in particular cases, where the dairy was an object, but certainly ought not to be a general practice.

† It has been remarked, that if a cow goes beyond her time, she generally produces a male calf.

‡ The following receipt for making hay-tea has been tried with success in the north of England. Take a large handful, or about 1 lb. of red-

in spring, when they are cheap; but linseed is the best substitute for milk. The calves are served with linseed twice a day, at the rate of an English pint of linseed, and twelve quarts of milk, for twelve calves, which, with thirty-six quarts of water, is boiled into a jelly; a gallon of this soup is given to each calf twice a day. The linseed should be crushed.

II. *Dairy Farms.* — The proper management of the dairy is a most important source of profit, in many parts of the kingdom, and perhaps ought to be extended to many districts where it is at present but little known *. In the neighbourhood of a town, the sale of the milk is, probably, the great object in keeping cows; but in the more remote parts of the country, if calves are not fattened, cheese and butter being so easily preserved and

red-clover hay, well got in, and six English quarts of clear spring water; boil the hay amongst the water, until it is reduced to four quarts; then take out the hay, and mix 1 lb. of barley, oat, or bean-meal, amongst a little water: put it into the pot, or cauldron, whilst it is boiling; keep the whole constantly stirring, until it is boiled and thickened. Let it cool, to be luke-warm; then give it to the calf, adding as much whey as will make a sufficient meal. This is a cheap mode of rearing calves, and may answer the purpose as well as more costly ingredients. In this way the valuable article of milk may be saved for other purposes.

* I regret much to hear, that in many parts of England the advantages of the dairy are not so well known as they ought to be; and that the lower orders of the people cannot get a little milk, or butter-milk, for their children. I wish much to call the attention of the liberal and public-spirited country gentlemen, to a circumstance so important to so numerous a class of the community. The best remedies are, to have small dairy farms in the neighbourhood of all villages, bound to furnish the inhabitants with milk, at a moderate price; and if the Irish mode were adopted by the English farmers, of churning all the milk, instead of the cream alone, such a supply of excellent butter-milk would be procured as would be of infinite service to their neighbourhood.

transported,

[redacted]

transported, are the proper articles to attend to, with the view of domestic consumption, or of foreign export.

The points to be principally attended to by any person who sets up a dairy, are, 1. To get a proper breed of milch cows. 2. To procure an attentive and skilful dairy-maid; as the whole success of the undertaking must depend on her good conduct *. And, 3. To ascertain whether the milk produced by the pastures in his possession, is best calculated for making butter or cheese.

The proper hours of milking, and how often *per* day cows ought to be milked, are points of considerable importance. It is certain that some cows require being milked thrice a day, in the prime of the season; but, as a general rule, it seems to be most adviseable to milk but twice a day, at six o'clock in the morning and six at night. In this way a cow has twelve hours each time to graze, or feed, and to prepare the milk for the pail. When they are milked thrice a day, it occasions much unnecessary trouble to the dairy-maids, not only in going to the cows, but also in preparing their vessels for holding the milk, unless they have an extraordinary number of them: it also puts the cows from grazing, and diminishes their time for rest †. The dairy-maid should take special care to treat the cows with as much gentleness and kindness as possible, to prevent their taking any dis-

* Good dairy-maids are so extremely scarce in many parts of the kingdom, that it would be proper to encourage them, by premiums at present applied for purposes much less essential.

† Since this was written, I have perused Dr. Anderson's Recreations, vol. III. p. 248, 249, &c. in which there are a number of valuable hints on the subject of the dairy, and in particular regarding the times of milking, respecting which there seems to be a degree of doubt, which nothing but careful and judicious experiments can properly remove.

like to her, which would hinder their milking well; and should milk them completely, by which cows are prevented from going so soon dry, as otherwise may be apprehended.

The usual process of making butter and cheese, and the purposes to which the whey may be applied, are so well known, that it is unnecessary here to describe them *.

Cows are not at their prime state for milk until they are six or seven years old, and they will remain so until

* The following particulars may be worth preserving in a note. Though fresh butter must be made with great care, yet salt butter requires, if possible, still greater attention, as it must be calculated for preservation; and though salt is indispensable for that purpose, yet if the butter is properly prepared, and the salt properly mixed, the quantity required is not considerable. It is said that the butter made in the months of May, June, July, and August, is the fittest for salting; and that butter made in the latter part of the season will not take salt so well. In regard to cheese, in order to make it rich, they sometimes mix fine tallow with it, and sometimes butter: the latter mode is practised in the northern parts of Scotland. Sometimes also, farmers, in the northern parts of England, make what are called egg cheeses, which are famous for toasting. After the curd is thoroughly prepared, they make this cheese, by putting five yolks of eggs to every pound of curd, mixing the whole properly, and putting it into the cheese-press as usual. As to whey, it is sometimes used for making butter, sometimes for feeding swine or calves, and sometimes prepared in the north of England in the following manner. The whey is put into a kettle or pot on a smartish fire, and when it is near boiling some butter-milk is put into it, which is skimmed off as soon as any curd seems to be formed on the top of the whey, some butter-milk is then again put in, and so on, from time to time, as long as any curds will arise. This substance is called whey-curds, may be eat with cream or milk, and is not unpalatable diet. The whey that remains from this curd is commonly called whig, and, when kept until it is sour, and two or three sprigs of mint put into it, many are of opinion that it makes a pleasant liquor, particularly in hot weather.

they

[redacted]

they are twelve; but as the older they grow the worse they will fatten, some farmers begin to feed them, when they are from eight to ten, even though they are good milchers. The propriety of this system may, however, be questioned. Whilst the value of the udder, in a good dairy cow, exceeds the value of the cow, her pasture, and the necessary attendance, she may be kept to any age. The teeth, not the stomach, fail; and therefore, as long as a cow milks well, she ought to be kept, as she can always be fattened by soft meat.

It has been remarked, that some cows will give a large quantity of milk, yet will yield little or no butter; and that a mixture of it will even prevent the cream of the other cows from churning. This is owing either to the animal being in an unhealthy state, or to a predilection for particular kinds of herbage, not favourable to the production of good milk.

III. *Grazing Farms.* Some intelligent graziers recommend the following mode for feeding and fattening cattle. Suppose there are four inclosures, of from six to ten acres each, one of them should be kept quite free from stock till the grass has got up; and then the prime or fattening cattle should be put into it, that they may get the best of the food; the second best should then follow; and the young store after all; making the whole feed over the inclosures in succession, as follows:

1.	Inclosure.	Free from stock, till ready for the best cattle.
2.	Ditto.	For the best cattle, till sent to No. 1.
3.	Ditto.	For the second best, till sent to No. 2.
4.	Ditto.	For the young cattle, till sent to No. 3.

No. 4 is then kept free from stock till the grass gets up, and it is ready for the prime cattle.

The proper size of inclosures has never yet been ascertained by experiment; probably from ten to thirty acres the best, but the size should be various, as small ones are best in winter, and large ones in summer, and small ones are best calculated for grass, and large ones for corn. Mr. Bakewell was a friend to small inclosures. Probably the best plan to adopt is, to feed cattle entirely in the house, or *soiling* them, as it is technically called. In that case small inclosures must be preferred, as the shelter they afford is extremely favourable to the growth of herbage.

In grazing cattle in the fields, two practices are recommended. 1. When hay is given them, or straw, instead of throwing it on the ground, which tempts the stronger to drive away, and even to gore and hurt the weaker; it is better to place it in small square pailings, according to the number of cattle in the field, so that each may have a distinct side to go to, without interfering with his neighbours. 2. When cattle are kept out during winter, it is a useful practice to rub some tar at the root of the horn, which hinders any wet from getting between the root and the skin, and it is said contributes to preserve the health of the animal, and to prevent various diseases to which it may otherwise be liable.

The larger a bullock is, he must take the more food to support him. It is desirable to change his food often, and to give him frequently, but little at a time, which makes him more eager to eat. After his kidnies are covered with fat he will take less meat every week. It is better therefore to ascertain the quantity he eats by the week than by the day.

Fatting cattle to be sold immediately from the farmer's house, and not sent to market, should be kept moderately warm. If kept too hot, it makes them perspire, and

and their skins to itch: this vexes them, and they rub themselves against any wall or post within their reach, which is much against quick feeding. Currying and combing them are useful practices; and washing them, at least once a week, is of great service. Bleeding is now exploded, as an old and unnecessary practice.

IV. *Suckling Farms.* In some parts of the kingdom, the whole attention of the farmer is dedicated to suckling, or, in other words, to feeding calves for supplying the market with veal. In Essex this plan is reckoned more profitable than the dairy, and next to grazing. But the profit there must depend much upon the immediate neighbourhood of that county to so great and certain a market as London,

The particulars connected with this branch of rural economy will, it is probable, be fully detailed in the Improved Agricultural Survey of Essex, in so far as regards that and the neighbouring districts. But as the mode of suckling adopted in some parts of Scotland is extremely different, it may not be improper to give a short account of it in this place.

As soon as the calf is dropped, it is put into a box made of coarse boards, four and a half or five feet long, and four, or four and a quarter feet high, and about two feet wide, according to the size of the calf. The boards are not put so close but that a sufficient quantity of air is admitted; light is, however, carefully excluded, and the box has a cover for that purpose *. The box stands on four feet, which at one end are four inches high, but at the other only two inches, and, as there are holes at

* All animals. when fattening ought to be excluded from light as much as possible, as the best and safest mode of keeping them quiet; and infinitely preferable to soporific drugs, which are commonly given them. Exclusion from light is practised by those who fatten poultry for the London market with much success.

the

the bottom, all wetness is drained off. The bottom is also covered with straw or hay, which is changed twice a week. For seven or eight days milk is but cautiously given, for, unless a calf is fed moderately at first, it is apt to take a loathing to its food. It should be bled in about ten days, and afterwards as much milk given it, fresh from the cow, either twice or thrice a day, as it will take. The bleeding should be repeated once a week; and at all times when a calf loaths his milk, and does not feed well, bleeding ought to be repeated. These frequent bleedings prevent diseases from plethora, to which calves are subject, even when not fed so high, and still more so when they are. A large piece of chalk should be hung up in the box, which the calf will lick occasionally: this contributes nothing to the whiteness of the veal, but it amuses the animal, and corrects that acidity in the stomach which might otherwise be engendered, and which certainly often takes place. A cow calf is reckoned the best for veal: if a bull calf is suckled, he ought to be cut when about a week old, otherwise the veal will neither be so good nor so white. By this mode of treatment calves are kept clean, quiet, warm, and dry; the veal they furnish is excellent, and they are soon ready for the market *; and, on the whole, it seems to be preferable to the practice of stupifying them with spirits, or with laudanum, so common in other places, where a different system is pursued.

V. *Farms where Cattle are worked.* The supposed necessity of beginning to feed oxen at an early age, is a great objection to their being generally used, as they are

* Statistical Account of Scotland, vol. VIII. p. 199, Vol. IX. p. 384, and, in particular, vol. XIX. p. 495, where an account of this mode is given, by a respectable country gentleman, Mr. Paterson, of Castle-Huntly.

hardly

hardly trained properly to work before it is thought necessary to fatten them, after which they do very little work: but, in consequence of the improved mode of fattening by oil-cake, &c. there is no difficulty to fatten oxen, even at twelve years of age, which is a material circumstance in their favour.

It is thought best to begin to break in oxen at three years old, and to give them full work at four. In the northern counties of England, four oxen are commonly used, the two foremost in harness, the other two in yokes. In Scotland it is not uncommon to work two oxen in harness, and without a driver. They are sometimes worked till they are from eight to ten, and even twelve years of age: but it is generally considered to be more profitable to begin to feed them earlier.

Some people prefer free martins * and spayed heifers for working to oxen. They are found very strong and active, and it is said they will, with equal feeding, work nearly as well as a horse.

It is a remark of the late Sir Charles Turner, that the advantage of working oxen depended much upon the breed; and he preferred much the Lancashire sort, as they were not only active and hardy, but lengthy in the carcase, which enable them to go four inches farther each step than almost any other kind.

They have much experience in working oxen in the East Indies; for, besides what are used in husbandry, great numbers attend the armies on all expeditions, for the purpose of dragging the artillery, and conveying ammunition, baggage, and provisions. It is observed in the East, that small oxen will travel much faster than

* Free martins are cow calves cast at the same time with bull calves, which are never known to breed.

large

large ones, and will bear more fatigue. Light oxen, with little food, will continue to work until they fall down, but the heavy ones will do nothing unless they are well fed. The heavy ones are stronger, but they are generally slow and surly, and can hardly be made to exert themselves on any occasion. It is also remarked in the East, that oxen ought never to be worked when their bellies are full, nor should water be given them, either on a march or when they are at work, if the weather is hot.

I cannot conclude these cursory hints, without adverting to a most interesting subject, namely, the diseases of cattle, and the means of their prevention or cure, inquiries regarding which are so well entitled to public attention and encouragement, instead of being left, as hitherto has been the case, to the desultory exertions of private individuals. The stock of domestic animals in a country, is one of the principal sources of its wealth; and every circumstance that materially tends to diminish their number, or to decrease their value, must be attended with much public loss. Animals are in general subjected to much fewer disorders than men; and as their diseases are of a much less complicated nature, they are consequently much easier relieved. There can be little doubt, therefore, that very moderate public encouragement would be the means of discovering those remedies that would be found the most effectual for their removal. Is it possible for the public money to be better bestowed? It is said that a very effectual remedy for the rot in sheep * has

* An intelligent correspondent informs me, that it is a custom with some farmers to pasture their sheep on ground abounding with broom, for several days, when the broom is in blossom, which they find from experience prevents the sheep so pastured from being infected with the rot for that season.

has been discovered in Holland, yet no pains are taken to procure a knowledge of it in this country, though that disease has occasioned the loss of many millions of property to the subjects of Great Britain within these fifty years past. If that loss had not been sustained, would not the wealth of the country have been considerably augmented, its public revenue consequently increased, and of course great quantities of human food have been preserved from destruction, which have perished, to the manifest injury of the nation!

Remarks on the Resistance of Fluids. By Dr. YOUNG.

From the JOURNALS of the ROYAL INSTITUTION of GREAT BRITAIN.

MR. Lacroix has inserted in the Bulletin de la Société Philomathique, a comparative view of the experiments of Mr. Bossut and of Mr. Vince, on the resistance of fluids striking on oblique surfaces. He does not appear to have assigned a sufficient reason for the difference of the results of those experiments; but the subject is of so much importance, as to deserve such an examination in its present state as may serve to assist in the prosecution of farther experiments.

The first approximation to a determination of the effect of the resistance to a body of a given section, terminated by oblique planes, is to suppose each particle of the fluid to impinge once on the surface, and then to retire for ever: on this supposition, the resistance ought to vary as the square of the cosine of the angle of incidence.

Another part of the resistance is occasioned by the adhesion of the particles of the fluid; this may be supposed

to vary, as the product of the secant and the sine of the angle of incidence; that is, as its tangent.

A third part depends on the form of the posterior surface of the body, and upon the unknown irregularities produced in the motions of the particles of the fluid, by the difference of the forms of its anterior part. It may be expected, that this negative pressure will be nearly uniform, when the shape of the posterior part of the body remains unaltered, as in Bossut's experiments; but that, when a thin surface is employed, as in Mr. Vince's apparatus, it will be somewhat diminished by the obliquity of that surface, even supposing the transverse projection of the surface to remain unaltered. This portion, however, may naturally be expected to be liable to great irregularities; and it appears to be somewhat increased when the thin surface is inclined in a small angle only.

In order to inquire how far these suppositions agree with the experiments, we may examine the curves of which the ordinates express the resistances. And if we make the abscisses equal to the squares of the cosines, the figure corresponding to the first part of the resistance will be a triangle. To this we may add a figure, of which the ordinates are in proportion to the tangents, and by comparing the results with the curves deduced from experiment, we may find what remains to be explained by the third supposition of a negative pressure, and other accidental irregularities.

Thus the ordinates of the curves R, B, and R, V, (see Fig. 5, Plate VI.) may represent the resistances determined by Bossut and Vince respectively: those of the line T, S, the first portion, proportionate to the square of the cosine; the distance between this line and T E, the second portion, proportionate to the tangent; and the distance between T V, and the former curves, the third

third portion, which, in Bossut's experiments, appears to decrease slowly, and almost regularly, while the obliquity increases, as might be expected from the analogy of other experiments. In those of Mr. Vince, on the contrary, this regularity is lost.

We may obtain a simple approximation to the results of Bossut, by neglecting the third portion, and adding to the square of the cosine one-tenth of the tangent: this approximation is represented by the curve R Y, which is tolerably accurate, as far as 70° of inclination. Mr. Eytelwein's formula (Journals, vol. I. p. 149,) gives the curve R E. The simple ratio of the cosines, represented by the curve R S, approaches nearer to the results of Mr. Vince's experiments than any of the other determinations.

I have before observed, that the resistance opposed by a fluid, to the motion of a surface moving obliquely through it, might be divided into three portions; arising respectively from impulse, from tenacity, and from negative pressure; and that in such experiments as those of Bossut, where the posterior part of the substance remains unaltered, the negative pressure might be supposed to be nearly constant, the resistance from tenacity to vary as the tangent of the angle of incidence, and the effect of impulse nearly as the square of its cosine.

Mr. Romme has remarked, that the facility with which the particles of the fluid can escape before the moving body, is proportional to the angular space of the fluid which remains open to admit them, and that therefore the resistance must vary in proportion to this angle. Without allowing the truth of the observation in its whole extent, we may with propriety inquire, whether or no the portion of the pressure derived from impulse may not in part depend on some simple function of the angle of

Method of obtaining perfectly pure Metallic Cobalt.

By M. TROMMSDORFF.

From the JOURNAL DE CHIMIE.

MIX one pound of the best safflower with four ounces of nitrate of potash and two ounces of pulverized charcoal, and throw this mixture, in small portions, into a red-hot crucible. Repeat the operation three times; after the third time leave the matter exposed for an hour to a white heat; agitate it quickly, and add four ounces of black flux; then remove the crucible into the furnace, and keep it red-hot for an hour. When cold, separate the reduced part of the cobalt, which, by the treatment it has undergone, has by this time lost a great portion of its arsenic and iron, but is not yet quite pure, since it may still be easily pulverized notwithstanding its natural density is considerable. It is then mixed afresh with three times its weight of nitrate of potash; the mixture is thrown, in small portions, into an ignited crucible, which is kept red-hot for a certain time. By this last operation the iron is completely oxydated, the arsenic is converted into acid, and combined with the potash. By levigation with warm water it is cleared from all saline particles, and the oxyd of cobalt is separated by the filtre. The oxyd is dissolved in a proper quantity of nitric acid; the solution is filtered, and evaporated to dryness. Then add fresh acid, expose it to a moderate heat, dilute with a sufficient quantity of water, filtre, in order to separate the last portions of iron, precipitate with pure potash, and reduce it.

Extract from a Memoir on the febrifuge Principle of Quinquina. By M. SEGUIN.

From the BULLETIN DES SCIENCES.

THE aim of the author in this paper was to indicate the means of discovering, with certainty, the real febrifuge principle of quinquina, of distinguishing those species which contain it from those which do not, and to ascertain the quantity and quality.

Hitherto a judgment has been formed of the quality of quinquina, only by the taste and by inspection; but as those methods established no fixed data, and could not be employed with quinquina in powder, the presence of the febrifuge principle was very imperfectly ascertained by them. It was therefore an object of considerable importance to substitute for those almost illusory methods, others not only reducible to calculation, but likewise invariable. Chemical re-agents alone were capable of effecting this purpose.

M. Seguin, in consequence, began with separating the respective properties of all medicinal substances, and examined their action upon all other chemical substances. These researches led him to the discovery, that the febrifuge principle of quinquina possesses very striking characters, which place it in a class distinct by itself.

These characters are; it precipitates the solution of tan, but does not precipitate solutions of gelatine and sulphate of iron. When quinquina does not possess all these characters, it is a proof that it has been adulterated, or that it does not contain the febrifuge principle.

To this test the author has submitted all the kinds of quinquina that he could procure of the apothecaries and druggists of Paris and Versailles, and invariably obtained the same results. His researches have proved, that a very small quantity of genuine unadulterated quinquina is to be met with in the shops, the greater part being either destitute of the febrifuge principle or adulterated, or else of inferior quality, though not mixed with any other substance.

These results are the more important as the effect of quinquina in fevers can depend only on the greater or less quantity of the febrifuge principle it contains, and as all those kinds of quinquina which are destitute of that principle, as well as the substances that may be mixed with them, are more or less pernicious to the system.

The researches of M. Seguin, on the febrifuge principle of quinquina, having proved that most kinds of quinquina sold in the shops are either detrimental or unserviceable, being either adulterated, mixed, or destitute of the febrifuge principle, he endeavoured to obtain a febrifuge principle invariable in point of quality, more efficacious, more certain in its effects, more easily assimilated with the human system, and so cheap that the vender can have no interest in adulterating it.

For this purpose the author endeavoured to discover the real cause of fevers, and their effects; the nature of the febrifuge principle of quinquina, and its effects on the system. He submitted every chemical and medicinal substance to the action of the re-agents above mentioned for the febrifuge principle of quinquina, and examined whether those substances which contained the febrifuge principle might not likewise contain other substances

substances pernicious to the animal economy; and, by curing fevers with these remedies he convinced himself of their efficacy, confirming his theory by very numerous experiments.

The new febrifuge principle which he proposes to substitute for quinquina, as combining all the advantages of that substance without any of its inconveniences, is gelatine in a state of the highest purity.

Considered in a medical, economical, and political view, gelatine, in its application to the cure of fevers, is much more advantageous than quinquina. It causes no irritation, procures peaceful slumbers, and a gentle perspiration, keeps the body open without cholic or heart-burn; has no disagreeable taste, restores the strength, and agrees with the weakest stomach, by which quinquina would be cast up again as soon as taken.

Quinquina, on the contrary, irritates the system, prevents sleep, has a disagreeable taste, frequently causes obstructions, and is very difficult of digestion. With regard to economy, the difference between the two substances is very material; the price of gelatine, compared to quinquina, being as one to thirty-two. Gelatine, besides, is indigenous, which quinquina is not; the commerce in the latter obliging the European nations to export a considerable amount in cash, which might be kept at home by adopting the use of gelatine.

To this memoir the author has subjoined an account of thirty-seven cures, performed with gelatine in the presence of respectable physicians, and requests that commissioners may be appointed to repeat the experiments, and to draw up a report on the subject.

 The

The persons charged with this commission are, Messrs. Portal, Dessesarts, Hallé, Fourcroy, Berthollet, and Deyeux. Their experiments are made at the School of Medicine, in an apartment exclusively devoted to these researches. A considerable number of patients have already been cured; and those gentlemen will very shortly present to the Institute their first report on those cures.

Memoir on Vinous Fermentation.

(Concluded from Page 73.)

I THEN sought, with the utmost attention, in the juice gooseberries, that animal matter which I considered as the real ferment: since it was insoluble by itself, it must exist in combination with a body which held it in solution. All the reagents which I employed to precipitate it were ineffectual; I had recourse to fermentation itself, and observed, under every circumstance, the phenomena which it produces. My experiments were made upon nearly one litre of juice, filtered, and perfectly clear; the apparatus was placed in a stove, where the thermometer stood, at 20 degrees; fermentation instantly ensued; a great quantity of carbonic acid was disengaged; much froth was formed; the liquor lost its transparency, and even became so turbid as to precipitate a deposit, which increased in quantity the nearer the fermentation approached to an end. This deposit, of a yellowish-white colour, was of a glutinous nature, and insipid; it became brown in the air as it dried, and acquired a slightly acid taste. When thrown upon ignited charcoal, it burned like animal matters; and, by distillation in a small retort, it yielded a great quantity of carbonate

[redacted]

bonate of ammoniac, ready crystallized. It produced fermentation in sugar in a very short time. In a word, it was a matter of the same nature as yeast. I was anxious to see whether this phenomenon is general; according to my manner of reasoning, I concluded that it must be. Experience soon convinced me, that it is common to all juices in fermentation; the juice of the grape, the cherry, the pear, the peach, the apple, decoctions of barley and wheat, afford yeast by fermentation. The juice of the grape yields a greater quantity than any of the others, but less than that of gooseberries; it is likewise slower in fermenting; the cherry and the peach furnish nearly an equal quantity. The pear and the apple yield very little, and this accounts for the slowness of their fermentation. I wish I had been able to procure a greater number of fruits, that I might have made a greater number of experiments; but these are sufficient to prove, that wherever alkohol is formed a deposit of yeast is generally found. If those who still entertain doubts on the subject will take the trouble to consider the two following experiments, I think they will be convinced. I confess they have contributed in no small degree to remove the objections that I myself was continually making. I knew that honey diluted with water is gradually converted into a spirituous liquor. Cullen informs us, that the urine of the diabetes mellitus in time becomes alkoholic. I fermented both of these, and a deposit of yeast was the consequence.

I therefore repeat, that it may be considered as a demonstrated proposition, that in all kinds of spirituous fermentation a deposit is formed of animal matter, similar in every respect to yeast, possessing exactly the same properties, and particularly that of decomposing sugar, and converting it into carbonic acid and spirit of wine. This

proposition gives rise to a new question, which naturally presents itself, and to which we must now direct our attention. Is yeast formed in the act of fermentation, or is it ready formed, and does it produce fermentation?

I must confess, that no experiments, hitherto made, positively prove that this matter alone is employed by nature to effect the conversion of sugar into alkohol and carbonic acid. For, why should it be deposited when the fermentation takes place? It may, indeed, be said, that the sugar holds it in solution; that it probably dissolves more than is required for its decomposition; and that the excess is then precipitated. But experience affords a feeble confirmation of this theory. Is this, however, a sufficient reason for totally rejecting it? Have we not many instances of compositions that require considerable time for their formation? and this is perhaps the case with the juices of fruits, where the ferment and the sugar are a long time in contact. It is certain, or at least extremely probable, that if yeast be a produce of fermentation, as it is deposed by all liquors that are fermented, it doubtless owes its origin to a soluble matter, from which it differs very little, and which produces it by its reaction upon the sugar.

Whichever of these two opinions may be confirmed by experiment, I have no doubt but that yeast is an immediate principle of vegetables, and consequently acts an important part in the phenomena both of art and nature. I am likewise persuaded, that if there exist any other matter capable of exciting fermentation, it must have a very great analogy to this; that, like yeast, it is composed of azote, oxygen, carbon, and hydrogen, and that it doubtless acts in the same manner upon sugar. I shall state, with the greatest accuracy, the properties of this matter, which I shall henceforth call ferment, and shall

particularly

particularly consider its action on the saccharine principle, that I may be able to establish the theory of fermentation. This theory, even supposing the yeast is not ready formed, but is produced in the fermenting juices, will still be useful, and susceptible of numerous applications, as will presently appear.

I shall say nothing more on the physical properties of ferment, of which I have spoken several times in this memoir; I shall only consider its chemical properties, which alone are materially interesting to us. It has no taste, does not redden the tincture of turnsol, nor turn the syrup of violets green. The putrid fermentation which it undergoes in time is similar in every respect to that of animal matter. By desiccation it loses three-fourths of its weight: this loss is entirely owing to the water it contains, and which is volatilised. When dried it is always capable of exciting fermentation; it is not in the least decomposed, and may be kept for any length of time without spoiling. Of this property we might even avail ourselves, to carry it to places remote from breweries, and with which the communication is so difficult, that it is impossible for them to receive fresh yeast, especially in summer, without being spoiled. By distillation in a small retort, and raising the fire to a melting heat, eight parts of ferment yielded 2,83 of carbon, as a residue; I obtained 1,61 of water, 1,31 of oil, and 1,46 of muriate of ammoniac; by adding muriatic acid I collected ,33 of gas, containing the fifth part of its volume of carbonic acid, and which, being separated from it by potash, burned like carbonated hydrogen, and required for its combustion ,5 more than its volume of oxygen. From this experiment it will be seen that ferment contains in particular a great quantity of carbon.

Water,

Water, at the temperature of 12 to 15 degrees, does not dissolve $\frac{1}{100}$ of ferment; it dissolves so little, that after remaining in contact several hours, and being well filtered, it scarcely acts at all upon sugar. Boiling water produces a decomposition which I shall examine in another memoir.

Nitric acid, even diluted with water to 18 degrees, likewise decomposes it, and converts it into grease; azote mixed with carbonic acid is first disengaged, and after some time nitric acid.

Potash acts upon this substance in the same manner as upon all animal matters; the phenomena of both are exactly the same; in both cases a saponacious matter is formed, and likewise a great quantity of ammoniac which is volatilised. But of all the properties of ferment, none is so remarkable, and at the same time so useful, and none, of course, is so deserving of being studied, as its action upon sugar; it interests every class of society from the artisan to the philosopher, on account of its produce; and the latter more especially, as it may prove a fertile souree of new reflections and truths. How much it were to be wished, that Lavoisier had, as he purposed, directed his attention to the subject, and had examined it with that care which he bestowed upon every thing he undertook. Who could be more capable of creating a theory of fermentation than the author of the modern theory? He was doubtless prevented by circumstances; and this theory, notwithstanding its importance to science, has, to the present time, remained vague, and founded on conjecture. Having discovered the fermentable principle, this theory naturally formed a part of my researches; and if I have not rendered it as luminous as I could wish, at least the veil with which it was

was covered is removed, and it rests upon reasonings which experience confirms.

To obtain the solution of this problem, I mixed various quantities of ferment and sugar; I observed in every case what took place in each, and confirmed, by other observations, what had been produced by the first. Sixty grammes of ferment, not dried, and 300 grammes of sugar, very soon began to ferment at a temperature of 15 degrees; in the space of four or five days all the saccharine matter disappeared; 51,5 litres of carbonic acid were disengaged; the liquor being filtered and distilled to two-thirds, yielded, by a second rectification, 863 grammes of brandy of 13 degrees; the apparatus was so disposed as to lose nothing, the lobes being refrigerated with marine salt and ice. I found that this quantity of brandy was equal to 171,5 grammes of alkohol, at 39 degrees. The residues of the distillation of the alkoholic liquor were poured into a capsule, and evaporated to dryness; the second yielded nothing; the first furnished about 12 grammes of nauseous matter, somewhat acid, and attracting, in a slight degree, the humidity of the air. I wished to investigate the nature of this acid, but the quantity was too small: Lavoisier asserts that it is acetous acid In another experiment, out of 60 grammes of ferment there remained 40 grammes of a substance which I thought more animalised than ferment itself. I I was much astonished, upon distilling it, to find that it yielded much less ammoniac. I then doubted whether fermentation would take place if I again mixed it with sugar; and if, by this method, all the azote would disappear. Accordingly, at the end of a week, having filtered the liquor, I obtained, for a residue, 30 grammes of a matter which, when distilled, afforded no trace of volatile alkali. I was pursuaded that azote would be disengaged

engaged with carbonic acid gas; to convince myself of it, I collected about 41 litres of carbonic acid in a bottle reversed, and filled with a solution of caustic potash. The whole was absorbed, which leaves no doubt respecting its purity. What then becomes of the azote? it must either exist in the residue of the ferment, or in the residue obtained by the evaporation of the alkoholic liquor, or in the alkohol; but the residue forms only half of the ferment employed; the quantity of matter proceeding from 300 grammes of sugar and 60 of ferment does not exceed 12 grammes; and neither of them yields ammoniac upon being distilled; while, on the other hand, ferment furnishes a great quantity. If these observations are correct, if I have accurately attended to all the phenomena, and have not been deceived, we must conclude that azote exists in alkohol; but I have in vain endeavoured to discover its presence in that liquid, in ether, and acetous acid; by making those bodies pass through ignited tubes, and burning the gas in Volta's eudiometer, by means of the electric spark, such a small quantity is obtained that it is not sufficient to decide the question; twenty-four or twenty-five parts of gas furnish at most but one of residue. I have, however, made several other experiments, which tend to prove that azote may exist in a substance, without being discoverable by distillation; that consequently it may be one of the component principles of vegetables, though they do not in general yield ammoniac upon distillation. But as I have not yet repeated these experiments, and as they are so important that too much caution cannot be used in announcing them, I purpose to revise and to vary them; I shall endeavour to appreciate all the circumstances, and, if I obtain convincing proofs, I shall not fail to communicate them to the class. These results, at least, afford us sufficient

ficient light to discover what passes in the act of fermentation; on this subject I cannot subscribe to Lavoisier's opinion. I do not think, like him, that all ready-formed carbonic acid proceeds from sugar. How, in this case, can the action of ferment upon itself be explained? I imagine that the first portions of acid are owing to a combination of carbon, ferment, and oxygen, with sugar, and that, by depriving the latter of a portion of this principle, the ferment excites fermentation. To elucidate this idea, I suppose a particle of sugar is composed of eight parts of oxygen, four parts of carbon, and one of hydrogen, which is not very remote from the truth, according to Lavoisier's experiments. One of these eight parts of oxygen seizes upon a fourth part of the carbon in the ferment, and thus the equilibrium between the principles of the sugar being destroyed, they combine, in a different manner, so as to form carbonic acid and alkohol. The ferment has, indeed, a great attraction for oxygen; this is proved, by its decomposing the air with the greatest facility; it is produced from carbonic and acetous acids, and the azote is set at liberty. If pure be used instead of common air, the reaction is still more speedy. I introduced 15 grammes of ferment into a bottle filled with pure air; I opened it in mercury; it had absorbed about one-fifth of its bulk; the ferment had turned sour; all the oxygen gas had imperceptibly disappeared, and was converted into carbonic acid: the temperature at which I operated was 15 degrees. From these statements we see what becomes of the carbon of the ferment; we shall see what takes place with the other principles by the account of the quantity of products resulting from a given quantity of matter put in fermentation, and by comparing the nature of the one with that of the other. From 60 grammes of ferment and 300 of

sugar, I obtained carbonic acid 95 grammes, pure alkohol 171,5 grammes, 12 grammes of extractive matter, a little acid, containing no azote; the residue of the ferment 40 grammes. These 40 grammes were found to contain 25 of ferment; so that only 35 had been employed for the decomposition of the sugar, and these 35 were reduced to 15 by a white substance *, insoluble in water, without action upon sugar, yielding no ammoniac by distillation, and leaving a charcoal which burns almost without residue; in short, exhibiting characters which distinguish it from every other, and which induce me to consider it as a distinct substance. Hence it appears, that the ferment takes away the oxygen from the sugar not only by means of part of its carbon, but likewise by a portion of its hydrogen; for the quantity of carbon which is given out by the ferment is too small to be alone the germ of fermentation; the azote disappears, and probably enters into the composition of the alkohol: the other principles of the ferment form acetous acid, and

* The ferment deposited by a juice in fermentation is seldom pure; in general it contains more or less of this white substance, which is sometimes so abundant that the deposit is almost entirely formed of it. It is of the mixture of these two matters that the dregs of different wines are, in a great measure, composed. All these effects depend upon the relative quantity of the ferment and the sugar: if there be much ferment and little sugar, the yeast will be pure; but, on the contrary, if there be much sugar and little ferment, the deposit will contain little yeast, or perhaps none at all: it will then be entirely composed of the white substance above mentioned, and the wine above will be, or may have been, saccharine. If ferment be only a produce of fermentation, it yet acts a distinguished part in this phenomenon; and if it be not the original cause of it, which is not certain, even in this case, at least it continues its production. This caused me to say above, that, in every point of view, nature presented us numerous applications of the theory which I am explaining.

a par-

a particular insoluble white matter, which is precipitated. The acetous acid remains in solution in the alkoholic liquor with an extractive substance, which doubtless proceeds from the sugar, and is of a nature foreign from the acid. It is not probable that the elements of the latter, re-acting upon each other, when the equilibrium between them is dissolved, form water; there is very little hydrogen in sugar, but there is a great quantity in alkohol: besides, by adding the quantities of carbonic acid, alkohol, extractive matter, and the residue obtained, we find within $\frac{1}{11}$ the quantity of matter which produced them. This loss must be attributed to the water contained in the sugar, and is by no means owing to the alkohol carried away by the carbonic acid. Of this fact I convinced myself by introducing above 30 litres of this gas into caustic potash; by distillation and rectification I obtained only a few grammes of liquid, the alkoholic taste of which was so weak as scarcely to be perceptible *. This theory appears to me the more probable, as it perfectly accords with facts; and this truth becomes particularly striking upon comparing them. I am far, however, from considering it complete. It will doubtless receive in time that perfection which it still wants. I myself hope soon

* M. Seguin has presented to the Institute a very different theory of fermentation. He thinks that in this operation the water is decomposed, that its oxygen seizes the carbon of the ferment, and produces carbonic acid, while its hydrogen flies off to the sugar, and converts it into alkohol. In order to admit this theory, a greater quantity of alkohol than there is of sugar ought to be obtained, whereas not much above half its weight is produced: besides, supposing that all the carbon of the decomposed ferment passes over to the state of carbonic acid, only a sixth part at most would be formed from that which is disengaged, as may easily be ascertained from the preceding statements. Another argument against this theory is, that sugar contains a great quantity of oxygen, and alkohol very little.

to add to its perspicuity. I know not whether I shall succeed in discovering what becomes of the azote of the ferment; but I shall not have much difficulty in determining, whether the residue, which is obtained, and which I consider as a substance, *sui generis*, be produced by fermentation as I believe; whether the sugar contributes to its formation, which is possible, or whether it exists ready formed, and is only deposited, which is contrary to all probability. I shall state the experiments that have removed all my doubts on this subject in a second memoir; in which I shall not only illustrate such points of this as may appear if not equivocal, at least not sufficiently grounded, but shall likewise collect all the details that form the sequel to it. Here, on the contrary, I have avoided them as much as possible, intending only to consider the phenomenon in a general manner.

Improved Method of preparing Mineral Kermes.

From Göttling's Pocket-Book for Chemists and Apothecaries for the Year 1803.

After deducing his principles of improvement from the elucidation of the nature and formation of mineral kermes, by Thenard, the author proposes the following method of preparation.

Reduce separately in powder, then mix together sixteen parts of crude antimony (sulphuretted antimony), twenty-four parts of purified potash (alkalinulated carbonate of potash), and three parts of flowers of sulphur (sublimated sulphur); put the mixture into a crucible, and reduce it to a state of complete fusion. When cold, pulverize

pulverize the mass, boil it half an hour with 128 parts of water, filtre the liquid while boiling through a fine cloth, let it run into a pan containing 156 parts of water, and leave it exposed to the action of the air in a shallow vessel, where it presents a considerable surface, from forty-eight to seventy-two hours, or till parts of a bright orange colour appear upon its surface.

Then decant the liquid, wash the matter deposited in a large quantity of water, remove it to a filter; after which it must be dried by a gentle heat.

This process furnishes twelve or fourteen parts of mineral kermes, of a reddish-brown colour; the whole of the antimony, excepting a small extraneous residue, dissolves, and is transformed into kermes; a very small quantity of the antimony remains in the liquor, under the form of yellow sulphur.

Memoir which obtained the Prize, proposed by the National Institute of France, on the Question, "To point out the Earthy Substances, and the Processes necessary for manufacturing Earthen-ware, capable of resisting sudden Transitions from Heat to Cold, and cheap enough for general Use." By M. FOURMY.

From the JOURNAL DES MINES.

WITHOUT doubt the Institute in making choice of this subject did not propose merely to obtain information concerning the compositions more or less proper for strictly fulfilling the conditions of its programme; it assuredly intended to produce a general improvement in the whole system of the manufacture of common earthen-ware throughout the territories of the republic.

I should

I should therefore conceive, that this end would be very imperfectly answered if I confined myself to a mere statement of the processes which afforded the results I am about to present. It is my intention to proceed a step farther, and to demonstrate that these processes may be employed not only in establishments formed on new principles, but even in those most devoted to the old methods of proceeding.

Object of the Question.

The fine earthen-ware, and even that of a middling sort, are not the kinds which we ought to be the most desirous to improve. The taste and wealth of the purchaser will not fail to stimulate the emulation of artists.

But our common earthen-ware is defective in many material points, the manufacture of it being consigned to the hands of men too enslaved to habit to give room to suppose that they will be anxious to make any improvements in which they have no personal interest. It is therefore the common earthen-ware that ought to occupy the attention of men of science, whose public character imposes upon them the honourable task of promoting the public welfare in whatever concerns the arts.

The question therefore relates to a kind of earthen-ware, for general use, within the reach of every class of people, that is, the cheapest possible. This question I shall endeavour to resolve not by a multitude of particular receipts, more or less depending on local or other circumstances, but by giving examples founded on general principles, and applicable, in every situation, with the greatest facility.

This question contains three essential conditions:

1. Resistance to sudden transitions from heat to cold.

2. Salubrity

2. Salubrity resulting from the absence of all pernicious oxyds.

3. Cheapness.

The greatest part of the earthen-ware made in the republic is sufficiently capable of resisting sudden transitions from heat to cold, and the price is extremely low, but it is covered with the oxyds of pernicious metals.

In many departments a stone-ware is made, the varnish of which contains no oxyds of pernicious metals, and which can be afforded at a very moderate price, but is not fit for resisting the alternatives of heat and cold.

France as yet possesses no kind combining the three conditions here prescribed. Before we proceed to the means of obtaining them altogether, let us turn our attention to those conditions, and likewise to several other particulars relating to the manufacture of earthen-ware.

Of the Resistance of sudden Transitions from Heat to Cold.

Few, however intelligent they may be in other respects, form a just idea of what occurs in the organisation of articles of baked earth, when they quickly pass from a very high to a very low temperature, and *vice versa.*

It is well known, that earthy substances are extremely bad conductors of caloric, so that it is absolutely combating against the nature of those substances to make of them utensils intended to transmit that fluid.

It would be too long here to enter into the detail of all the obstacles resulting from a kind of inconsistency, which can only be justified by motives foreign to the present question. I shall only insist on one important observation; that a multitude of difficulties, in the execution, are combined with those arising from the nature of the substances themselves, to render articles composed of baked

baked earth far inferior to those of metal, with regard to the resistance of sudden alterations of temperature. These difficulties, which are very great in *heating*, are very much augmented in the *cooling*.

It is obvious, that if earthy substances heat much more slowly than metals, they must likewise cool more slowly: hence it follows, that the excellence of articles of baked earth consists, not only in their capability of enduring every sudden change of temperature, but likewise of resisting that from heat to cold better than from cold to heat.

Of Salubrity.

The substances composing the body, or, to employ the technical terms, the paste or biscuit of common earthenware in general, contain nothing prejudicial to health. But this observation does not apply to the varnish with which these wares are covered. These always contain a greater or less quantity of lead, which the addition of oxyds of copper, or other metals, contributes to render still more dangerous.

Thus, with regard to salubrity, it is impossible to make any improvement in the paste or biscuit of common earthen-ware; an alteration of the varnish, or covering only, must be attempted.

Of Varnishes.

The paste of common wares, intended to withstand sudden alterations of temperature, is almost always of such a soft texture as to absorb liquids and greasy substances. To remedy the inconveniences resulting from this disposition, the paste or biscuit is covered with a varnish, which, by the closeness of its texture, prevents all humidity from penetrating.

Baking,

Baking, it is well known, is a principal portion of the expense in the manufacture of baked earths, less perhaps on account of the quantity of fuel consumed, than the risks by which it is attended.

When the heat is raised to a very high degree, the expense of fuel is doubtless increased, but in a proportion very easily estimated; on the contrary, the risks and the precautions necessary for avoiding them augment the price in a proportion almost beyond calculation. Hence arises the excessive difference in price between articles requiring a very high temperature and those for which a low degree of heat is sufficient.

The degree of temperature is almost always regulated by the fusibility of the varnish, which explains the reason why manufacturers confine themselves to such compositions, for varnish, as are most easily fused.

There are, however, limits which the most rigid economy cannot exceed, without altering the quality of the manufacture. At low temperatures only such compositions can be vitrified as contain an excess of lead or alkali; and this kind of vitrification is easily decomposed for no other reason but because it does not receive a sufficient degree of heat.

An elevated temperature would, without doubt, produce varnishes less defective than those in general obtained; but, in the present state of the manufacture, this would sacrifice the only advantage they possess, that is, the economy resulting from a low temperature. Besides, with whatever care these varnishes may be made, they are always extremely tender, and liable to chip off, consequently they do not long preserve their lustre.

It would therefore be advisable to abandon such compositions for others of a more solid nature, which by their salubrity and duration would amply compensate

 the

the increase in expense for baking, and for wholesome varnishes. These may be distinguished into natural and artificial.

Of natural Salubrious Varnishes.

The natural varnish is that polish acquired by certain kinds of earthen-ware in arriving at the state of *stone*. This effect of the vitrification of the surface, which is in some degree natural, is more or less promoted by the alkali and lime of ashes put in motion in the oven. In many manufactories it is accelerated by the vapour of muriate of soda introduced into the oven towards the conclusion of the baking.

These kinds of varnish are subject to many disadvantages which subtract greatly from their merit.

1. They are always imperfectly fused, as the workman is obliged to lower the temperature before they are completely melted. Being produced only by the commencing vitrification of the exterior surface of the biscuit, which precedes that of the interior portion only by a few degrees, it is conceived that, if the fire were continued till the vitrification of the surfaces is complete, the inside would be softened to such a degree that the wares would drop to pieces.

2. They are unequally spread, being produced by a cause which does not act with regularity, that is by the operation of the flame, and the vitrifying substances which it carries along, and deposits on its passage. That fluid is not equally powerful in every part of the oven. Its passage is more or less aided by the intervals left between the different articles, and these intervals themselves are irregular, being great between large articles, small between those of smaller dimensions; besides which, the course of the flame through the oven causes its

its effects to be more powerful on one side than on the other.

Thus, on all wares covered with natural varnishes, there are inequalities which are insufferable, excepting on very coarse articles.

3. Lastly, these varnishes can scarcely be formed but on wares incapable of withstanding the sudden alternatives of heat and cold.

It is obvious, that the exterior of an earthy composition cannot be subjected to a degree of heat sufficient to obtain of itself a complete varnish, but the interior must at the same time acquire a degree of vitrification that prevents the necessary expansion and contraction required by the alternatives to which vessels intended to bear fire are exposed.

We cannot therefore recur to natural varnishes, if we wish that the articles should preserve the texture which is necessary for them: to endure sudden transitions from heat to cold we must employ artificial varnishes.

Of artificial Salubrious Varnishes.

I have already said, that salubrity is not absolutely incompatible with compositions of which lead forms a part, if they were submitted to a degree of heat sufficient to vitrify them completely. But the expense of the lead, added to that caused by the increased consumption of fuel, would make these compositions far too dear for common wares. The same reason of economy forbids the use of saline compositions.

The only compositions by which these objections can be obviated, are such as are purely earthy. These must obtain the preference, not only because they are least expensive, but because they are capable of bearing the friction of hard bodies.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Action for Damages for taking an undue Advantage of the Commnnication of an Invention, and obtaining the King's Patent, to the Prejudice of the Inventor.

Common Pleas, Westminster-Hall, Dec. 6, 1803, before Lord ALVANLEY *and a Special Jury.* *

SMITH *v.* DICKINSON.

THIS action was brought by the plaintiff, a sadler, in Bond-street, against defendant, (the proprietor of Gowland's lotion), to recover damages for the injury he had sustained by the defendant's availing himself of a communication which plaintiff had made to him, of an invention for which plaintiff was about to take out a patent.

It appeared from the statement of Mr. Serjeant Best, counsel for the plaintiff, that some years ago the plaintiff had obtained a patent for an apparatus to give play or elasticity to the girths of saddles; and that defendant had, so late as November, 1801 *, obtained a patent for an apparatus to answer the same purpose, but having heard of the plaintiff's invention, he called on him, in order to see how far the two inventions resembled each other. They were found to be the same in principle, but different in the mode of applying them. The plaintiff then informed the defendant that he had an invention far superior to either of them, and for which he intended to take out a

* Published in the sixteenth volume of the first series of this work, p. 294.

patent;

patent; for that he found the former plan did not succeed in *retaining* the elasticity. The defendant much wished to see the plan, but the plaintiff then refused to let him. On the 12th January, 1802, the defendant signed a memorandum, admitting that the plaintiff had contrived various articles in the way of his business, which he conceived to be new and valuable improvements. And that defendant was desirous of being made acquainted with one of them, which he fully comprehended, under the title of Spring Apparatus, to produce the same effect as that for which defendant had obtained a patent, he, defendant, by such memorandum, pledged himself not to take advantage of such communication, "under the penalty of breach of honour, and 1,000 *l.*" Whereupon plaintiff shewed defendant a rude sketch of the invention, which he could not comprehend until the plaintiff explained it to him by means of a common snap mouse-trap, which he had provided for the purpose. The defendant was satisfied with the simplicity and usefulness of the invention, and assured plaintiff that the agreement for their being jointly concerned in the patent should be carried into effect, &c. Minutes of which had been before taken by Mr. William Nicholson, of Soho-square, in order to enable him to give instructions to defendant's solicitor to prepare a proper instrument between them. After some time, plaintiff was informed the defendant had actually taken out a patent himself. An explanation was required; and plaintiff was so far convinced of the defendant's solemn assurances, that the proposed agreement should be carried into effect, that he was induced to attend at Mr. Nicholson's, in order to give instructions respecting the specification. It was then perfectly understood, that the parties were to be jointly concerned in the business, though the patent had been obtained

tained by defendant solely, without the plaintiff's consent. The patent being complete, some months passed, but defendant would not come forward to enter into the agreement; plaintiff was therefore alarmed; and after making several applications to defendant, he at last received a letter, dated May 29, 1802, to the effect following. "Sir, I am unconscious of any contract at present "between us, nor can Mr. Nicholson or Mr. Foulkes "help me to the recollection of any, although you refer "me to them for that purpose. The two inventions * "for which I have obtained patents are my own inventions. Prior to my giving you a paper not to practise any invention you might communicate, *I had deposited a drawing in the hands of a friend* †, *and had a* "*workman actually employed in making the article for which* "*my last patent is obtained. And this drawing was deposited* "*for the purpose of proving, should it be necessary, what my* "*design and invention consisted of prior to any communication from you, least even, if it should be the same, I might* "*still go on to obtain my patent.* How far your invention resembled mine is of no consequence; I went on "with my own. Your communication had in it nothing "new, therefore I do not consider myself as using your "invention, but my own. One of the things you "shewed me from your drawer is a very clever invention ‡, and which in my new business § I should

* Alluding to his of November, 1801, and the late one of plaintiff's.

† The circumstances attending the deposit of this drawing will most probably appear in our statement of this case at the future hearing, some of the facts having come out since the present trial.

‡ Alluding to new inventions, for which Smith proposes to take out a patent, as we are informed.

§ Dickinson actually opened a sadler's shop, but sold every thing off just before the trial.

"like

"like to use; but although it is in my power I will not "use it. I hope, therefore, you will take out your pa- "tent, and secure it to yourself in time. It is almost "too tempting, to be in the possession of the knowledge "of a thing so useful, as well as flattering to a man's va- "nity as the invention, and not to make use of it. If "you will bring it out, you shall have all the further as- "sistance necessary, and which I can give; but if you "will not, I should almost think it right to publish it "myself, as it is doing no good where it is. If you will "not bring it out, say upon what terms I shall do it, as "I think it almost indispensable. I shall be at home till "eleven this morning, if you think it worth your while "to call. I am, &c."

As defendant by this letter denied all knowledge of the Agreement, and asserted that he was the inventor, the plaintiff commenced this action.

It was proved on the trial, that the plaintiff was the inventor of the apparatus; and Mr. Nicholson stated that from what passed in his presence between the plaintiff and defendant, he understood they were to be jointly concerned in the patent; and that the invention was the plaintiff's, from whose instructions and plan Mr. Nicholson prepared the specification *.

Several reputable witnesses were also called, to prove the novelty and utility of the invention; who shewed that an elasticity of no less than five inches was given to the girths by the action of the springs, and created an ease and freedom of respiration to the horse that has in vain been long desired; and that by its adoption horses will not be liable to be hurt or galled by the rubbing of the saddle, as they frequently are by the girths not being

* Published in the first volume of the second series of this work, p. 247.

tight, which they will endeavour to prevent by blowing themselves out, in order to enjoy greater power of respiration.

The defendant's counsel, Mr. Serjeant Shepherd, contended that the plaintiff, by attending the making out the specification, had consented to the patent being taken out in the defendant's name; and that therefore the defendant had not taken an undue advantage of the communication; and stated some legal objections in support of his argument. He also attempted to shew that the invention was not of any value, and offered to give the patent to the plaintiff, if he chose to take it; but he called no witnesses.

Lord Alvanley said he was glad the case had assumed a different aspect from what he expected; for it would have been impossible to have believed that the defendant was the inventor if he had not twenty witnesses to swear he was so, after the facts that had transpired. But the question of fact was altered to a question of law, which he always wished to have decided by the full court rather than by a judge sitting at *Nisi Prius*. That the plaintiff had been grossly ill used was evident, and was entitled to some compensation, for there could be no doubt if any advantage had been taken an action would lie. The question therefore was, whether the defendant had taken the advantage laid in the declaration? (which he read.) And after recapitulating the evidence, he left it to the jury to consider,

1st. Whether the invention in the sketch is the same as in the patent?

2d. Whether, at the time of taking out the patent in defendant's name, the defendant had the plaintiff's assent to take it out so?

3d. As to the subsequent consent.

4th.

4th. As to the damages actually sustained by the plaintiff, the defendant having undertaken to assign the patent to plaintiff at his own expense?

The jury retired about half an hour, and returned a verdict for the plaintiff 300 *l.* damages, and 40 *s.* costs.

That the plaintiff shall have an assignment of the patent made to him, his executors, administrators, and assigns, for the remainder of the term therein to come and unexpired; and that such assignment be made at the expense of the defendant, which the defendant, by his counsel, consented, and undertook forthwith to do.

And the jury found the facts following.

That the invention of the plaintiff is the same as is contained in the specification of the patent obtained by the defendant; and

That the plaintiff, by assisting at the meeting in Soho-square, and in making out the said specification, virtually agreed that the patent should be in the defendant's name.

The plaintiff is also to be at liberty to move the Court of Common Pleas, that a verdict for 1000 *l.* may be entered for the plaintiff if the court shall be of opinion, that the 1000 *l.* mentioned in the agreement, bearing date the 12th of January, 1802, is in the nature of liquidated damages, and not in the nature of a penalty. And if the court shall be of opinion, that the defendant has not taken an undue advantage of the plaintiff, then a nonsuit to be entered *.

* As this matter is intended to be argued before the Judges of the Court of Common Pleas next term, we shall endeavour to procure, and lay before our readers, an accurate report of the fate of the verdict upon such special argument.

Infringement of a Patent.

King's Bench, Guildhall, Dec. 23, 1803, *before Lord* ELLENBOROUGH *and a Special Jury.*

HUDDART *v.* GRIMSHAW.

This was an action brought by the plaintiff for infringement on his patent for "a new mode or art of making great cables and other cordage, so as to attain a greater degree of strength therein, by a more equal distribution of the strain upon the yarns *."

The plaintiff obtained his patent in 1793. The defendant Mr. Grimshaw visited him in 1799. On this occasion he requested the plaintiff to permit him and his partner to adopt his method of rope-making at their great ropery in Sunderland, to which Captain Huddart replied that he had no objection, provided the gentlemen with whom he was concerned would give their consent. A letter was soon afterwards sent to the plaintiff by the defendant's partner, returning thanks for the plaintiff's civility, and renewing the request that he would permit them to *adopt his method of rope-making at their ropery only, without premium.* To this letter the plaintiff, after consulting his partners, returned an answer, containing a positive refusal.

From that time it was proved, that the defendant carried on his manufacture in a private manner, shutting up his work-place, and suffering none to enter it excepting persons in whom he could confide; and, as it was alledged, practising part of the plaintiff's invention.

In support of the plaintiff's case, several witnesses were examined.

Mr. Gibbs, for the defendant, asserted, that this action was brought as a bill of discovery, in order to find

* See the specification in the present number, page 81.

out

out by what means the defendant was enabled to manufacture ropes, equal in quality to the plaintiff's, and bring them to market at a cheaper rate. If he could only make this discovery, the plaintiff was unconcerned about the fate of the present action. He would, however, be disappointed, continued the learned counsel, for his client would not let him into his secret. There was no proof, he contended, that the defendant had infringed on the plaintiff's patent, and that the former was not obliged to discover how and in what manner he was enabled to make as good cordage as the plaintiff. He then argued that the plaintiff had, in his specification, described certain parts of the machinery as his own invention, though they had actually been before invented by a Mr. Balfour, who had obtained a patent for the same *. The defendant's patent could not therefore be valid. In point of law, a person must take out a patent neither wider nor narrower than his invention; the specification must be sufficient to enable a workman of skill to perform the thing described. And he contended that the plaintiff could not maintain his patent because it is wider.

The defendant called no witnesses.

Lord Ellenborough, after stating the principal points of the law relative to the case, recapitulated the evidence, and observed that there was certainly *prima facie* evidence that the defendant had made use of part of the plaintiff's invention; but he left it to the jury to consider whether or not it was an infringement of the plaintiff's patent.

The jury, without retiring, returned a verdict for the plaintiff.

* See the specification in the second volume of the first series of this work, page 145.

Smithfield

Smithfield Club.

The annual exhibition of prize cattle took place on Friday, December 16, in Wootton's Yard, Smithfield, and the next day the club met at the Crown and Anchor Tavern. There was a numerous and respectable attendance; the Duke of Bedford was in the chair. After dinner the chairman rose to state to the company the manner in which the prizes for the last year had been adjudged.

Mr. Gray (of Tracey Park, near Bath) mentioned to the company a remedy for the disease of scouring in cattle, which had been found to be of the most efficacious kind. Several of his cattle had been attacked with this disease, and he had applied various remedies: all of them had, however, proved ineffectual, till he had made trial of Mr. Bellamy's Bath Powder, the effect of which had been so direct and immediate, that he felt it his duty to recommend it to the attention of the public.

Lord Somerville corroborated this opinion of the efficacy of Mr. Bellamy's powder for the cure of the above disease in cattle. He thought it deserved the serious attention and support of all those of whom the Society was composed.

New Thermometer.

M. De la Lande has presented to the Institute a new thermometer, the degrees of which appear to the author more conformable to philosophical principles, and more convenient, than those of Reaumur. He places Zero at the temperature of 9½, and 31 instead of 26. He remarks, that the numbers 30 and 40 are those of the degrees of heat in summer and cold in winter, 30 for moderate summers and mild winters; 40 for hot summers and intense winters. Mossy, the most celebrated maker of thermometers at Paris, known for the accuracy of his works, has already begun to execute the new thermometers.

Society

Society for improving the Condition of Chimney Sweepers.

The following persons have undertaken to sweep chimneys by mechanical means, in pursuance of the plan prescribed by the Committee of the Society for superseding the necessity of climbing boys, by encouraging a new method of sweeping chimneys, and for improving the condition of children and others employed by chimney-sweepers.

Richard Page, chimney-sweeper, No. 23, Colonnade, near Guildford-street, Foundling-Hospital.

Thomas Wood, No. 36, Poland-street, Oxford-road.

Thomas Taylor, No. 9, Wells-street, Oxford-road.

George Smart, No. 15, Great Bell-alley, Coleman-street, at his timber-yard, Pratt's-place, Camden Town, and at Ordnance-wharf, Westminster-bridge.

George Turner and James Laver, Walthamstow.

Bath and West of England Society for the Encouragement of Arts, Manufactures, and Commerce.

The annual meeting of this Society was held at Bath, December 13, 1803. Many lots of neat cattle, sheep, and pigs, both fat and for breed, having been exhibited in the usual manner for the premiums, committees of inspection were appointed to report on the respective merits; competent committees were also chosen, for the purpose of ascertaining the merits of the several agricultural implements, &c. produced by the Society, as well as for the inspection of cloth and wool.

At this meeting, premiums to the amount of 209 *l.* 2 *s.* 6 *d.* were adjudged.

The Bedfordean gold medal will be presented to the author, who, at or before the first meeting in November, 1804, shall produce to the Society the best essay, founded on practical experience, on the nature and properties of

of manures, and the mode of preparing and applying them to the various soils; in which essay shall be pointed out the best and cheapest manner of collecting and preparing the different kinds of manures, and of the state, season, and quantity, in which they should be applied.

List of Patents for Inventions, &c.

(Continued from Page 80.)

BOOTH HODGETTS, of Dudley, in the county of Worcester, Nail Ironmonger; for machinery for rolling iron for shanks, and for forming the same into shanks for nails. Dated November 8, 1803.

RICHARD YOUNGER, of Pittman's-buildings, Old-street, in the county of Middlesex, Gentleman; for an improved method of extracting worts from malt, barley, and other grains and substances. Dated November 12, 1803.

WILLIAM FREEMANTLE, of Bunhill-row, in the parish of St. Luke, Old-street, in the county of Middlesex, Watchmaker; for improvements in the construction of steam-engines. Dated November 17, 1803.

JAMES BEVANS, of Castle-street, City-road, in the county of Middlesex, Carpenter, being one of the society of the people called Quakers; for methods of applying machinery for the purposes of more expeditiously striking, or sticking mouldings, and for rabbetting, ploughing or grooving, fluting, and excavating, wood, in every manner, now usually performed by any kind of plane. Dated November 19, 1803.

GEORGE PENTON, of New-street-square, in the city of London, Brass-founder; for an improvement on lamps, commonly called Argand's lamps. Dated November 19, 1803.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XXI. SECOND SERIES. Feb. 1, 1804.

Specification of the Patent granted to STEPHEN HOOPER, *of Walworth, in the Parish of Saint Mary, Newington, in the County of Surrey, Gentleman; for certain Machines or Machinery, upon improved Principles, and Methods of using the same, for the Purpose of cleansing of dry and other Harbours, Rivers, Creeks, Bars of Harbours, and preventing Bars from making, reducing Banks or Shoals, opening a Channel through Sands at Sea, or clearing away the Sand or Beach to get off Ships grounded by Accident or Stress of Weather on Sands, and for other Purposes.* Dated February 3, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Stephen Hooper do hereby declare that my said invention is described by the above drawings, and the following explanation thereof; that is to say: Fig. 1 (Pl. VII), the apparatus for the back water and the reservoir, which may be erected either in a concave form, or any other which local

local circumstances may require, in any place where the waves of the sea come up to the harbour's mouth or near to it, as at the letter A. It may be built of any dimensions with timber or other materials; but the larger the reservoir the greater will be the force of the back water, and the proportion should be about thirty feet in length to twenty in breadth.' If built of timber, a number of square piles B must be placed at about two feet asunder. and of such a length as, when driven sufficiently deep, to leave the upper part of them on a level with the top of the pier-head. A row of these piles being placed in front, another row must be driven close to the pier-head to answer to it, and a range to form each end. The front and back rows must be strongly fixed or locked together by timber C, framed across and keyed, and the piles at the ends in like manner; for the whole must be sufficiently strong to confine the body of water contained in it; and to withstand the action of the sea against it, the front part of the reservoir, and the end next the sea, must be supplied with a number of blocks or pieces of timber D, about twelve inches square, framed between the piles from the bottom to the top, to be flush or square with the inside of the piles, for valves to shut against; these blocks must be placed about one foot asunder, and thus openings will be formed between the piles of about two feet wide, by one foot deep. The whole of the front and the end next the sea must be formed with these openings, to each of which a flap, or valve E, must be so fixed, that it may open inwards, and freely admit the water, when the waves drive against the reservoir; and then, by closing when the wave draws back, prevent the water from returning. Thus a large quantity of water will be continually collecting. The bottom of this reservoir must be covered with stones or boards to prevent the

water

water passing through; the back part of it and the side next the harbour must be strongly planked within the piles to confine the water, that part only excepted which communicates with the tunnel. For at the lower part of the reservoir, on the side next the harbour, a sufficient opening must be left to admit the mouth of a tunnel, or tube FF of proper dimensions and length to convey the water from the reservoir to the upper part of the harbour. This tunnel or tube FF must be fixed along by the inside of the pier-head close to the ground, and filled with a number of sluices GG, about ten feet distant from each other. In cleansing a dry harbour, the person employed to superintend the business must at high water open the sluice next above the water's edge; and when the sea runs high, the next below it (for the water in the tunnel will, by the action of the waves on the reservoir, be considerably higher than the tide itself, or level of the water in the harbour; and the current from the sluice or sluices will drive the soil it meets with into the water); and as the tide ebbs he must open another sluice, and then another, during the whole ebb or while the water will flow from them, which it will do at all times when the waves beat against the reservoir; this process will scour, from each part of the harbour along the head in succession, a quantity of soil proportioned to the height of the tide, and of the water driven into the reservoir.

Fig. 2. Horizontal windmill. A, the oak part of the mill which may be built upon an octagon square or any other form, from twenty feet diameter more or less, by fourteen feet deep more or less, with posts B, to be braced or otherwise secured; the outside to open and shut like Venetian blinds, DD, or with a number of valves, or with shutters, or otherwise, either on an horizontal or perpendicular direction, to admit the wind coming into the

 building

building on the weather side, and to fall down or shut to prevent the wind going out on the leeward side on the top of the building. At E, must be a bay or circle for a fly wind wheel F G, to work between in a horizontal direction; this fly wheel F G, is fixed upon an upright shaft; the inside part of this wheel next the shaft at G, must be boarded close, about seven feet and a half from the centre, to form a rim fifteen feet diameter, more or less, to fasten thirty floats or flyers upon, more or less, of a length to work as close to the bay or circle at E, as possible, each float two feet and a half broad, more or less, fixed upon an angle of about ten degrees, more or less. This mill may be built on any suitable building to carry forward any kind of manufactory.

Fig. 3, is a machine for pecking up rocks under water, so as to open or assist in making a navigation, A A, two views of a lighter or vessel, B B B B, are peckers prepared for pecking of stone fixed at the end of iron bars or spars C C C C, of a sufficient length to reach the pecks the vessel is riding over, the upper end of the bars or spars to have a number of notches to hook upon catches as are fixed on the side of the vessel, these peckers are worked by the rolling of the vessel; when the side is down the notch on the spar or bar hooks to the catch at *a*, on the side of the vessel, and when that side rolls up the lower part of the spar or bar, presses against the ship's side at *d*, frees the catch at *a*, and the pecker falls down with velocity to peck up the stone at the bottom. Each bar or spar must have a guide at *e*, to steady the upper end with a roller at the back part, to let the spar slip up and down, by which there must be a weight hanging on a pulley fixed on the centre of the vessel communicating to the roller, to draw the upper end of the spar or bar to the vessel's side on her rolling down, and

and to admit of its freeing the catch on her rolling up. *f* the weight, *g* the pully, *h* the roller. These peckers may be fixed by different machinery, to work by the motion of the vessel. Where the vessel has no motion, the peckers may be worked by the roller D, working round this roller, extending fore and aft on each side of the vessel as far as the peckers extend, with a number of cogs about three parts round the roller, for a set of cogs fixed to each spar or bar to work into. On the rollers going round, the bar is raised up till it comes to that part of the roller where there are no cogs, when it frees itself and drops down with velocity to peck the stone. These rollers may be put in motion by manual labour, horse, wind, or water, and may be worked by different machinery.

Fig. 4, a shifting keel to assist ships, hoys, barges, or other vessels in going to windward. A A A represents the bottom, side, and end of a barge. The keel forty feet long, more or less, in three pieces or lengths B B B, more or less, two feet deep by three inches thick, more or less, to fasten together at the ends by hooks and rings, or otherwise, which form a joint convenient for putting together or taking to pieces. On the upper and lower edges of the keel at each joint, and in the middle part of the after length, and the fore part of the foremast length are chains fixed, as at *a*, *b*, *c*, *d*, to confine the keel to the bottom of the vessel in a perpendicular direction, and to keep the middle part of the after length in the centre of the bottom at *a*, the chains to be confined as tight as possible. The other three pair of chains, *b c d*, when going to windward, a portion of each chain must be veered away from the lee side to keep the keel straight one part with the other, about four degrees from a line with the main keel or middle line, fore and aft with the vessel

vessel as *per* the figure; the keel being in this position will draw the vessel to windward when going through the water; observe when the chains to leeward are veered away to take in those to windward, and when put about, to veer away the other chains to shift the keel on the opposite angle, but on making short tacks the keel may be kept centering fore and aft, by taking in on each side an equal quantity of the chains; if the vessel will not stay with a common helm, by veering away the chain *d*, till the foremost length of the keel is about four degrees more across, will assist in bringing her about. When the water is too shallow for the keel, by slackening the lower chain on one side, and taking in those on the opposite side will trace the keel to lay flat to the bottom of the vessel, or it may be taken on board; this keel may be made all in one piece, made fast by joints, hooks, or otherwise, to the side or bottom of the main keel, to admit of its hanging up and down, and kept in that position by chains, ropes, or otherwise, to admit of its being traced up to the vessel's bottom, or her taking the ground or coming into shallow water.

Fig. 5, two views of a lighter or vessel for scouring away bars, &c. A A, lighter or vessel forty feet long, more or less, by sixteen feet broad, more or less, with three wells at the bottom, B C D, one on each side and one in the centre, the bottoms to be level with each other from side to side of the vessel, the middle well C, to be ten feet square, more or less, the sides straight up about three feet, more or less, and then to contract to about eight feet at the top, more or less, and may be built up of a height level with the deck; the two side wells B and D, twenty-eight feet long, more or less, the sides next the well C, may be continued upright about three feet, and then a deck laid across to make the upper part

part light, the ends, forward and aft, to be built up square with the top of these side wells, the whole to be made water-tight. To let the water into the outer wells B and E, must be six holes, more or less, E E E E E E, cut through each side of the vessel's bottom, each hole to be about twelve inches square, the lower part level with the bottom of the well, the foremast and aftermast of these holes to be kept as near to the ends as convenient, and the others divided at nearly equal distances, to have a valve on the inside of each hole to admit of the water flowing into the well, on the side rolling down, and closing on the vessel's raising up, to prevent the water returning out again; the wells B and D, communicating with the well C, by four holes F, through that part adjoining the side wells B D, with valves on the inside of the wells C, to admit of the water discharging from the outside wells into well C, and prevent its returning, by which means a body of water will be raised in well C, above the level of the water without side the vessel, in proportion to the rolling of the vessel by the agitation of the sea or by other means. The water may be raised likewise by the vessel's pitching; when the water flows in the fore part of the side wells B and D, and when raising up, there being a middle partition in the side wells at G, the water will discharge itself into the middle well at F, the same in the after part of the vessel when falling, and raising the head of the water in well C, is conveyed into a trunk or small well H, about two feet square, communicating with a hole cut through the vessel's bottom, as near the centre as convenient to admit of a tunnel I, to convey the water through to reach down to the ground to scour away all the soil, &c. This tunnel may be made of canvas or other fit materials of different lengths to lace, or other-

otherwise fasten together, to lengthen or shorten as the depth of water may require.

Fig. 6, improvements upon a water-wheel for raising water secured by patent, bearing date the tenth day of November, one thousand eight hundred and one, as described in my specification. A, a square case or cylinder made water-tight seven feet wide, more or less, by thirteen feet long or high, more or less; B B B, the bay or reams for the wheels to work between; C C C, the wheels for raising the water with four floats, more or less, fixed on one shaft F; D D D, a floor or partition under each wheel, made to hold water with eight holes E E E, more or less, of a sufficient size to admit of the water coming through each hole to have valves E E E, fixed with hinges or otherwise on one side, the other side permitted to open about seven inches, which will cause the water that comes through to flow in a circular direction, contrary or opposite to that which the wheel works upon, which will assist the raising of the water. These partitions and bays for the wheels to work in must be kept about three feet asunder, or as far as one wheel will raise the water up for the other to take hold of it; and by increasing the number of water wheels, &c. the water may be raised to any height, and the pace or velocity for the wheels to work to raise the water, will be about sixty revolutions per minute.

Fig. 7, A, a water-wheel fixed upon an horizontal direction, 12 feet diameter, from the outer part of the floats, more or less; B B B, 16 floats, more or less, 2 feet long by 2 feet broad, more or less, fixed on an angle of ten degrees, more or less, on the outer rim of the wheel at A, eight feet diameter covered with boards close home to the shaft, to prevent the water passing through. This wheel

wheel is fixed on a shaft C, the lower end working in a step fixed on the ground, the wheel being fixed on the shaft upon a level with the tail water in a bay D D, for the floats of the vessel just to work clear, and built secure to prevent the water from dispersing with an opening to that part next the sluice at E, to admit of the water flowing or forcing under the wheel A, which will put the wheel in motion, with a power equal to the head of water. The floats of this wheel may be put upon a perpendicular direction as Fig. 9.

Fig. 8, a water wheel and tunnel for scouring away sand or loose soil for getting a ship off the sand or main; A, the water wheel six feet diameter, more or less, described in section of the wheel, Fig. 6. B B, the frame seven feet square, more or less, of a sufficient depth for the wheels to work clear of the bridge-trees C C, for the upper and lower gudgeons of the shafts that the wheels A E and F, are fixed on to work clear. D D, a circle or bay for the water wheel A to work between. F, a cog wheel about twenty-seven inches diameter, working into a cog wheel E, about nine inches diameter, fixed on the main shaft that the water wheel A is fastened to. At the upper end of the gudgeon of the shaft that wheel F is fixed upon, is an universal joint affixed with a hook or an eye to fasten the end of a small cable or hawser G, by turning round of which, will put the water wheel A in motion; the frame B being covered over with canvas or other fit materials, to prevent the water dispersing out at the top, except upon one square, where an opening must be left about two feet, with a short tunnel H, pointing down to direct the force of the water to scour away the ground: the frame B B must have a ring at each corner to fix ropes K K K K, to lower the frame down within about one foot of the ground, and a rope to each

of the outer corners to guy the frame to that part of the ship where the ground is wanted to be scoured away; the cable G being fastened, one end to the shaft that wheel F works upon, the other end brought on board and fastened to a hook with an universal joint, the work may be put in motion by a wye wheel with an endless rope winch, or other proper means prepared for the purpose, to fix at any part of the ship; the cable to be guyed up at different parts as at I I I, to lead it clear. N. B. The multiplying wheels F and E, if required, may be fixed with the wye wheel, &c. &c. to work at the upper end of the cable on board the ship, and the lower end of the cable being made fast, as before described, to the upper end of the shaft of the water wheel A.

Fig. 9, a wheel twelve feet diameter with a rim A A on the outside, to which the upper part of the floats B are fastened. These floats are to be thirty inches long, more or less, fixed upon an angle of ten degrees, more or less, and connected together by a rim C C at the lower ends, which rim must be kept down close to the bay E, Fig. 2, and at D D, Fig. 7, to prevent as little wind or water as possible passing under the vessel. The upper end at rim A A being closed into the centre, to prevent the wind or water passing through that part of the wheel, the wheel will be put into motion by the water acting against the parts in passing through, according to the head of water; this wheel may likewise be worked perpendicularly, the open part or the rim at the end of the floats C C, to work as close to one side of the bay as possible for the wheel to have freedom to work; by letting the water into the wheel through that side of the ends to which the floats are fastened, fronting the stream or tide when the water is forcing through between the floats, will put the wheel in motion to carry forward any work

Fig. 4.

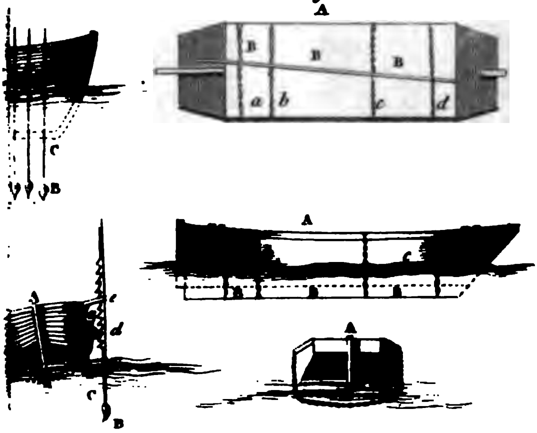


Fig. 7.

Fig. 8.

[redacted]

work according to the strength. N. B. When the wheel is made to work in the tide, then the floats may be twelve feet long, more or less. The scouring away the ground for getting ships off the sand (as per Fig. 8.) being an entire new principle, though it is evident it may be performed by various other machinery, yet I conceive that will be an infringement of my Patent.

In witness whereof, &c.

Specification of the Patent granted to JAMES BEVANS, *of Castle Street, City Road, in the County of Middlesex, Carpenter, being one of the Society of the People called Quakers; for Methods of applying Machinery for the Purposes of more expeditiously striking or sticking Mouldings, and for rabbetting, ploughing, or grooving, fluting, and excavating Wood in every Manner now usually performed by any Kind of Plane.*

Dated November 19, 1803.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said James Bevans do declare, that the object of my invention is to perform the operations of striking or sticking mouldings, rabbetting, ploughing, grooving, fluting, or excavating wood in a much more expeditious manner than that now practised, by substituting in lieu of manual labour the machinery hereafter described.

These operations are to be performed by the planes or other instruments now used for similar purposes, or with such alterations as are necessary to adapt them to the machinery. These instruments are to be used either singly or combined in any number, according to the

 width

entirely omitted, the quadrants being retained in their position by sliding in grooves, fixed a little above their centres, in which case stops are to be affixed at each end of the stroke to tilt the quadrants, and by this means effect the purpose intended to be answered by the bearing shaft, of supporting that end of the planes which is off the wood, by throwing the pressure of the quadrants on the other end of the same; but in this case the connecting rod must be fixed to the box or frame.

The Figs. 1, 2, 3 and 4, are drawn to a scale of three inches to the foot. And Fig. 5, is drawn to the scale of half an inch to the foot *.

In witness whereof, &c.

Specification of the Patent granted to ELIZABETH BELL, *of Hampstead, in the County of Middlesex, Spinster; for an artificial Method of sweeping Chimneys, and of constructing them in such a Manner as to lessen the Danger and Inconvenience from Fire and Smoke.*

Dated May 10, 1803.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Elizabeth Bell, in pursuance of the said proviso, in the said letters patent, do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed; that is to say: My artificial method of sweeping chimneys is carried into effect by means of certain apparatus, fixed, or applied, or used at the top and bottom of the flue of any chimney, by means of which a chain or rope can be drawn up and down, and is made to carry certain other apparatus, consisting of brushes or scrapers, or other fit instruments for

* These drawings have been reduced to suit the size of our plate.

cleansing

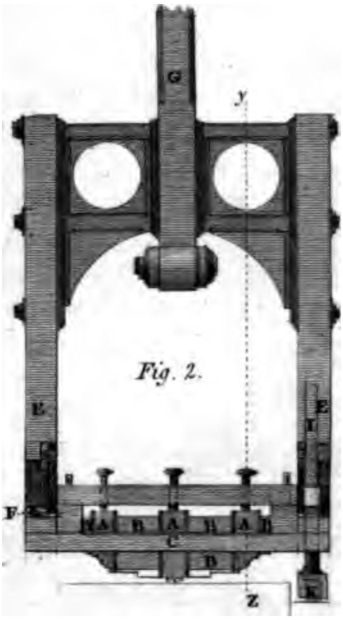
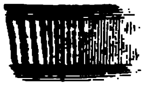


Fig. 2.



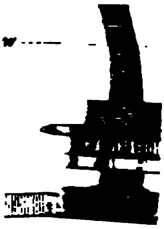
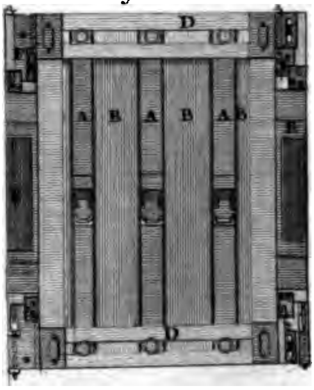


Fig 3



cleansing the chimneys, and I do construct and make all the said apparatus, instruments, and things so intended to be used, of various forms, and in various relative operations, as are hereafter more particularly set forth; that is to say:

First, I fix on the top of the chimney, or stack of chimneys, a frame, consisting of rods of iron, or other fit metal or materials, united at top either by cross bars or otherwise, or meeting in a point; which said frame is intended to form a support for one or more pullies or rollers, for the purpose of leading or conducting a metallic chain or rope from the bottom of the chimney to the top, and thence downwards, to support and work the sweeping apparatus; should any apprehension be entertained, that the point of the above bars should attract lightning, the usual conductors may easily be attached to it.

Secondly. One of the sweeping apparatus consists of a block, body, or main-piece of wood, or other proper material, in the form of a square prism, or of such other form, and of such length, as may be found convenient with regard to the chimneys intended to be swept, and a pipe or tube is to be passed through the middle of the said block, body or main-piece, and fixed therein, usually in the direction of the greatest dimension or length of the same. One extremity of the chain before described is fixed to the upper part of the said block, body or main-piece, and serves to raise or lower the sweeping apparatus or sweeper when introduced into the chimney, and the other part of the aforesaid chain, after passing over the pulley or rollers at the top of the chimney, is returned and conveyed down to the bottom, through the said tube, which defends and prevents it from touching or injuring the other parts of the said sweeping apparatus. It must, therefore, be understood, that the position of the said block,

block, body or main-piece when in the chimney must usually be such that the said tube will be in an upright position. To the sides of the said block, body or main-piece are affixed certain levers or bars, each moving severally on its own joint in planes of direction, or from the central tube aforesaid; but, nevertheless, so loosely as to the said joint that the said lever shall be also capable of moving to the right and to the left of the said several planes of motion. The joint in each of the said levers is usually at some point nearer the upper than the lower extremity thereof, and the said lower extremities are fitted up or armed with brushes or brooms of hair wire, or other fit material, or scrapers of wood or metal, for the purpose of sweeping and cleansing the chimney, when the sweeping apparatus shall be drawn up and down by means of the chain. From each of the said levers I pass a cord or rope over a pulley duly placed in the block, body or main-piece aforesaid, wherein the same is fastened to a weight lodged within a cell to the said block, body or main-piece, and the said weights serve by their reaction to urge the lower extremities of the levers outwards against the sides of the chimney with a due pressure, and the levers on each side are provided with strings and a weight as aforesaid.

Or otherwise, I produce the same outward pressure by means of springs of the kind called curb-springs, or of any other of the well-known forms proper to answer that purpose.

And farther, I cause other ropes or cords to pass from the lower branches of the said levers through a ring or eye, and over a friction roller or rollers, near the extremity of the middle tube before described, in such a manner that all the said ropes shall unite in one, and pass downwards, so as to give the workman or operator the power of drawing the lower branches together when any occasion

occasion may render the same necessary. The tube or pipe must be long enough above the top of the levers to pass up the pot at the top of the chimney, and must be armed or fitted with a proper brush to sweep and cleanse the upper part of the chimney above the space where the sweeper is allowed to ascend, and the ascent of the said sweeper must be limited, by means of a stop of any fit figure, to apply against the framing at top, when its sweeper is at its intended limit.

Thirdly, Instead of the sweeper herein-before described, I sometimes construct and use another middle or intermediate apparatus, consisting of a structure of the form of an egg, or nearly so, made of wood and leather, or other flexible material, and covered with brushes of hair or wire, or scrapers, as may be requisite. I call this my elastic sweeper, and I construct the same of three, four, or more pieces of wood connected together longitudinally, or otherwise, in the direction intended to coincide with that of the flue of the chimney. And as it is my intention that the said pieces of wood should possess a power of elastic expansion or relative motion outwards, and also yield inwards when compressed by the narrowness of the flue, or by any other force, I connect and join the same by means of leather or cloth, in the manner of bellows, or by cords, or jointed rods, or otherwise, so as to admit of the said expansion or relative motion; and I give and produce the requisite elasticity by springs duly placed within; and the said springs may be strait or helical, or of any other figure, provided only that the same be so made and placed as to cause the said pieces of wood duly to recede from each other, whenever the absence of external pressure, or the state of the leather, or flexible connecting material, shall permit the said effect. The elastic sweeper here described being drawn up

 and

and down the flue of any chimney, will sweep and cleanse the same, and will, in some cases, be preferable to the sweeper first described.

Fourthly, The apparatus at the bottom of the chimney consists of a frame of wood, or other material, so made as entirely to cover the front or opening of the chimney into the room, and to defend the hearth, the grate, and the apartment, from the soot. The use and application of this frame affords sufficient instruction to a workman to construct the same. Upon the frame within the chimney I place two or more rollers, for the purpose of working the chain, by means of handles attached to the axis, which pass through the wooden frame into the apartment; so that, with one roller to raise, and another to draw down the sweeper, the whole operation becomes perfectly manageable and easy. And I usually form an opening in the frame, closed by a flap or door, through which the working can be occasionally examined, and the cords, chains, or strings, for regulating the levers, may be accessible, and every other necessary attention paid to the process.

Fifthly, I do likewise carry my said artificial method into effect, in other cases, by an apparatus consisting of rods of iron fixed at the top of the chimney as before, but terminating in one common place of junction, from which a spindle or vertical bar descends into the chimney, and serves as the support for a frame, either square, or nearly answering to the figure of the chimney, within which it is thus supported on a level, without touching the walls, and serves to support, sustain, or bear out a chain near the walls or inner surface of the chimney; and the said chain carries a brush, or proper implement or instruments for sweeping and cleansing the chimney when drawn up and down therein. Another frame, nearly similar, is to be placed at the bottom of the chimney,

and

and the brush will sweep the different parts or sides of the said chimney, accordingly as the same shall be drawn up and down against the different sides of the said frames; and in this construction or apparatus for carrying my said artificial method into effect, I pass the chain over a pulley at the top as before, but moveable by a swivel. And I do also occasionally, or for the most part, fix the axis of my lower rollers for the chain in a swivel-piece, by which the same can be adapted to the different situations; and, instead of handles as aforesaid, I work the said rollers by a crank, or by any other obvious and well-known method or means. In some cases also, I place a wheel of metal or wood on the said spindle or vertical bar, to regulate the situations of the chain as to the different sides of the chimney; and I use the said wheel either with or without the frame within the chimney; and I regulate the said positions or situations by a rotatory motion in the said wheel at the top, or by a correspondent and similar wheel at the bottom, at pleasure. And in all these, and similar operations described under the title fifthly, I occasionally groove or flute the face of my working rollers, in order that the chain may move, or be led in any one of the same at pleasure. Or otherwise, I cause the chain to pass through the notches of a rack, for the same purpose.

Sixthly, In some chimneys, instead of the elastic sweeper, I simply use a cylinder, fixed with brushes of hair or wire, or scrapers, which is worked as first shewn and explained.

Seventhly, I sometimes produce a rotatory motion, by a wheel filled with a sufficient quantity of cord, which is put upon the chain, and drawn up and down the chimney.

And, generally, in case the chimney required to be swept or cleansed should be actually on fire, I then attach to the chain of any of the apparatus herein-before described, a vessel of tin, or other material not liable to be

broken, and filled with water, which vessel is provided with a valve, or shoet or slider, at its lower part, which may be opened by pulling a line or small chain; and will thereby permit the water to flow out through a simple aperture or spreading nozel; and I, by the means aforesaid, convey the said vessel to the place where the fire is burning, or to a higher situation, and thus extinguish the same by letting out the water from the vessel.

Lastly, My method of constructing chimneys consists in forming certain blocks or masses of brick or pottery, or other sufficiently cheap, durable, and incombustible materials, having a perforation of the dimensions of the intended flue and serving to form a part or portion of the sides or walls thereof, as to the whole circumference or dimensions of the same, taken horizontally, or in a section across the said flue; and I build the chimney by placing the said blocks, bricks, or masses, upon or beside each other, so that the cavities therein shall form one flue; and for the more perfect application and joining of the same, I fashion the said blocks or masses with projecting fittings, which enter and close within each other, as is seen in some snuff-boxes, or with other fittings or overlappings, suitable and proper for the purpose; and I make good the joining with mortar or plaster, or luting or loam, or iron cramps, with lead or metallic hooping, or in any other good and workman-like manner, so as to exclude all possibility of any communication of fire to the beams or other part of the house. And, in order to form the angles, deflections, or curvatures of chimneys, I fashion or make some of my blocks or masses with the faces of application inclined to each other, and not parallel, as for the most part I do make them; and I do make the internal cavity, and external surfaces, of such dimensions and figure as may best suit the intended purpose.

In witness whereof, &c.

Specification

[redacted]

Specification of the Patent granted to JAMES ROBERTS, *of Abbotston Farm, in the County of Southampton, Yeoman, and* GEORGE CATHERY, *of New Alresford, in the same County, Gentleman; for completely and effectually eradicating Smut from Wheat; and that Wheat when cleansed by this Invention will produce Flour of as good Quality and Value as Flour made from Wheat of the best Growth.* Dated July 6, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said James Roberts and George Cathery do hereby describe and ascertain the nature of our said invention, and in what manner the same is to be performed, as follows, that is to say: The said invention for eradicating smut from wheat consists of mixing the same with lime made from stone, or white or grey chalk, and is used in the following manner; namely, the lime, when slack, to be sifted through a fine sieve, and then mixed well with the wheat, in proportion to the degree of smut, from one to two bushels to a load of five quarters; it then must be passed through a machine; in general once will be sufficient to make the wheat fit for the miller, but, if intended for sale, it will frequently be necessary to pass the wheat through the machine twice, and in some cases three times. The machine is made of wire, with brushes within, upon the same principle as the machine in common use for dressing flour, except that the wire is stronger and coarser.

In witness whereof, &c.

Account of some Experiments on the Descent of the Sap in Trees. By THOMAS ANDREW KNIGHT, *Esq.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

IN a Memoir which I had the honour to present to you two years ago *, I related some experiments on trees, from which I inferred, that their sap, having been absorbed by the bark of the root, is carried up by the alburnum or white wood, of the root, the trunk, and the branches: that it passes through what are there called the central vessels, into the succulent part of the annual shoot, the leaf-stalk, and the leaf; and that it returns to the bark, through the returning vessels of the leaf-stalk. The principal object of this Paper is, to point out the causes of the descent of the sap through the bark, and the consequent formation of wood.

These causes appear to be, gravitation, motion communicated by winds or other agents, capillary attraction, and probably something in the conformation of the vessels themselves, which renders them better calculated to carry fluids in one direction than in another. I shall begin with a few observations on the leaf, from which all the descending fluids in the tree appear to be derived. This organ has much engaged the attention of naturalists, particularly of M. BONNET; but their experiments have chiefly been made on leaves severed from the tree; and, therefore, whatever conclusions have been drawn, stand on very questionable ground. The efforts which plants always make to turn the upper surfaces of their leaves to

* See Phil. Trans. for 1801, p. 333.

the

the light, have with reason induced naturalists to conclude, that each surface has a totally distinct office; and the following experiments tend strongly to support that conclusion.

I placed a small piece of plate glass under a large vine leaf, with its surface nearly parallel with that of the leaf; and, as soon as the glass had acquired the temperature of the house in which the vine grew, I brought the under surface of the leaf into contact with it, by means of a silk thread and a small wire, adapted to its form and size. Having retained the leaf in this position one minute, I removed it, and found the surface of the glass covered with a strong dew, which had evidently exhaled from the leaf. I again brought the leaf into contact with the glass, and, at the end of half an hour, found so much water discharged from the leaf, that it ran off the glass when held obliquely. I then inverted the position of the leaf, and placed its upper surface in contact with the glass: not the slightest portion of moisture now appeared, though the leaf was exposed to the full influence of the meridian sun. These experiments were repeated on many different leaves; and the result was, in every instance, precisely the same. It seems, therefore, that in the vine the perspiratory vessels are confined to the under surface of the leaf: and these, like the cutaneous lymphatics of the animal economy, are probably capable of absorbing moisture, when a plant is in a state to require it. The upper surface seems, from the position it always assumes, either formed to absorb light, or to operate by the influence of that body; and, if any thing exhale from it, it is probably vital air, or some other permanently elastic fluid. It nevertheless appears evident, in the experiments of BONNET, that this surface of the leaves

leaves of many plants, when detached from the tree, readily absorbs moisture.

Selecting two young shoots of the vine, growing perpendicularly against the back wall of my vinery, I bent them downwards, nearly in a perpendicular line, and introduced their succulent ends, as layers, into two pots, without wounding the stems, or depriving them of any portion of their leaves. In this position, these shoots, which were about four feet long, and sprang out of the principal stem about three feet from the ground, grew freely, and, in the course of the summer, reached the top of the house. As soon as their wood became sufficiently solid to allow me to perform the operation with safety, I made two circular incisions through the bark of the depending part of each shoot, at a small distance from each other, near the surface of the mould in the pots; and I wholly removed the bark between the incisions; thus cutting off all communication, through the bark, between the layers and the parent stems. Had the subjects of this experiment now retained their natural position, much new wood and bark would have been formed at the upper lip of the wounds, and none at all at the lower, as I have ascertained by frequent experiment. The case was now different: much new bark and wood was generated on the lower lip of the wounds, become uppermost by the inverted position of the branches; and I have no doubt but that the new matter, thus deposited, owed its formation to a portion of sap, which descended by gravitation, from the leaves growing between the wounded parts and the principal stems.

The result of this experiment appears to point out one of the causes why perpendicular shoots grow with much greater vigour than others: they have probably a more perfect and more rapid circulation.

The

The effects of motion on the circulation of the sap, and the consequent formation of wood, I was best able to ascertain by the following expedient. Early in the spring of 1801, I selected a number of young seedling apple trees, whose stems were about an inch in diameter, and whose height, between the roots and first branches, was between six and seven feet. These trees stood about eight feet from each other; and, of course, a free passage for the wind to act on each tree was afforded. By means of stakes and bandages of hay, not so tightly bound as to impede the progress of any fluid within the trees, I nearly deprived the roots and lower parts of the stems, of several trees, of all motion, to the height of three feet from the ground, leaving the upper parts of the stems and branches in their natural state. In the succeeding summer, much new wood accumulated, in the parts which were kept in motion by the wind; but the lower parts of the stems and roots increased very little in size. Removing the bandages from one of these trees in the following winter, I fixed a stake in the ground, about ten feet distant from the tree, on the east side of it; and I attached the tree to the stake, at the height of six feet, by means of a slender pole about twelve feet long; thus leaving the tree at liberty to move towards the north and south, or, more properly, in the segment of a circle, of which the pole formed a radius; but in no other direction. Thus circumstanced, the diameter of the tree from north to south, in that part of its stem which was most exercised by the wind, exceeded that in the opposite direction, in the following autumn, in the proportion of thirteen to eleven.

These results appear to open an extensive and interesting field to our observation, where we shall find much to admire, in the means which nature employs to adapt the

forms of its vegetable productions to every situation in which art or accident may deposit them. If a tree be placed in a high and exposed situation, where it is much kept in motion by winds, the new matter which it generates will be deposited chiefly in the roots and lower parts of the trunk; and the diameter of the latter will diminish rapidly in its ascent. The progress of the ascending sap will of course be impeded; and it will thence cause lateral branches to be produced, or will pass into those already existing. The forms of such branches will be similar to that of the trunk; and the growth of the insulated tree on the mountain will be, as we always find it, low and sturdy, and well calculated to resist the heavy gales to which its situation constantly exposes it.

Let another tree of the same kind be surrounded, whilst young, by others, and it will assume a very different form. It will now be deprived of a part of its motion, and another cause will operate: the leaves on the lateral branches will be partly deprived of light, and, as I have remarked in the last Paper I had the honour to address to you, little alburnum will then be generated in those branches. Their vigour, of course, becomes impaired, and less sap is required to support their diminished growth: more, in consequence, remains for the leading shoots; these, therefore, exert themselves with increased energy; and the trees seem to vie with each other for superiority, as if endued with all the passions and propensities of animal life.

An insulated tree in a sheltered valley, will assume, from the foregoing causes, a form distinct from either of the preceding *; and its growth will be more or less aspiring,

* Not only the external form of the tree, but the internal character of the wood will be affected by the situation in which the tree grows; and

[redacted]

aspiring, in proportion to the degree of protection it receives from winds, and its contiguity to elevated objects, by which its lower branches, during any part of the day, are shaded.

When a tree is wholly deprived of motion, by being trained to a wall, or when a large tree has been deprived of its branches, to be regrafted, it often becomes unhealthy, and not unfrequently perishes, apparently owing to the stagnation of the descending sap, under the rigid cincture of the lifeless external bark. I have, in the last two years, pared off this bark from some very old pear and apple-trees, which had been re-grafted with cuttings from young seedling trees, and the effect produced has been very extraordinary. More new wood has been generated in the old trunks, within the last two years, than in the preceding twenty years; and I attribute this to the facility of communication which has been restored between the leaves and the roots, through the inner bark. I have had frequent occasion to observe, that wherever the bark has been most reduced, the greatest quantity of wood has been deposited.

Other causes of the descent of the sap towards the root I have supposed to be capillary attraction, and something in the conformation of the vessels of the bark. The alburnum also appears, in my former experiments, to expand and contract very freely, under changes of temperature and of moisture; and the motion thus pro-

and hence, oak timber which grew in crowded forests, appears to have been mistaken, in old buildings, for Spanish chesnut. But I have found the internrl organization of the oak and Spanish chesnut to be very essentially different. The silver grain and general character of the oak and Spanish chesnut, are also so extremely dissimilar, that the two kinds of wood can only be mistrken for each other by very careless observers. Many pieces of wood found in the old buildings of London, and supposed to be Spanish chesnut, have been put into my hands; but they were all most certainly forest oak.

duced must be in some degree communicated to the bark; should the latter substance be in itself wholly inactive. I however consider gravitation as the most extensive and active cause of motion, in the descending fluids of trees; and I believe, that from this agent, vegetable bodies, like unorganized matter, generally derive, in a greater or less degree, the forms they assume; and probably it is necessary to the existence of trees that it should be so. For, if the sap passed and returned as freely in the horizontal and pendent, as in the perpendicular branch, the growth of each would be equally rapid, or nearly so: the horizontal branch would then soon extend too far from its point of suspension at the trunk of the tree, and thence must inevitably perish, by the compound ratio in which the powers of destruction, compared with those of preservation, would increase.

The principal office of the horizontal branch, in the greatest number of trees, is to nourish and support the blossoms, and the fruit or seed; and, as these give back little or nothing to the parent tree, very feeble powers alone are wanted in the returning system. No power at all had been fatal; and powers sufficiently strong wholly to counteract the effects of gravitation, had probably been in a high degree destructive. And it appears to me by no means improbable, that the formation of blossoms may, in many instances, arise from the diminished action of the returning system in the horizontal or pendent branch.

I have long been disposed to believe the ascending fluids in the alburnum and central vessels, wherever found, to be everywhere the same; and that the leaf-stalk, the tendril of the vine, the fruit-stalk, and the succulent point of the annual shoot, might in some measure be substituted for each other; and experiment has proved my

my conjecture, in many instances, to be well founded. Leaves succeeded, and continued to perform their office, when grafted on the fruit-stalk, the tendril, and succulent shoot, of the vine; and the leaf-stalk, the tendril, and the fruit-stalk, alike supplied the branch grafted upon them with nourishment. But I did not succeed in grafting a fruit-stalk of the vine on the leaf-stalk, the tendril, or succulent shoot. My ill succes, however, I here attribute solely to want of proper management; and I have little doubt of succeeding in future.

The young shoots of the vine, when grafted on the leaf-stalk, often grew to the length of nine or ten feet; and the leaf-stalk itself, to some distance below its juncture with the graft, was found, in the autumn, to contain a considerable portion of wood, in every respect similar to the alburnum in other parts of the tree.

The formation of alburnum in the leaf-stalk seemed to point out to me the means of ascertaining the manner in which it is generated in other instances; and to that point my attention was in consequence attracted. Having grafted a great many leaf-stalks with shoots of the vine, I examined, in transverse sections, the commencement and gradual formation of the wood. It appeared evidently to spring from the tubes which, in my last Paper, (to which I must refer you,) I have called the returning vessels of the leaf-stalk; and to be deposited on the external sides of what I have there named the central vessels, and on the medulla. The latter substance appeared wholly inactive; and I could not discover any thing like the processes supposed to extend from it, in all cases, into the wood.

The organization of the young shoot is extremely similar to that of the leaf-stalk, previous to the formation of wood within it. The same vessels extend through both; and

and therefore it appeared extremely probable, that the wood in each would be generated in the same manner; and subsequent observation soon removed all grounds of doubt.

It is well known that, in the operation of budding, the bark of trees being taken off, readily unites itself to another of the same or of a kindred species. An examination of the manner in which this union takes place, promised some further information. In the last summer, therefore, I inserted a great number of buds, which I subsequently examined, in every progressive stage of their union with the stock. A line of confused organization marks the place where the inserted bud first comes into contact with the wood of the stock; between which line and the bark of the inserted bud, new wood regularly organized is generated. This wood possesses all the characteristics of that from which the bud was taken, without any apparent mixture whatever with the character of the stock in which it is inserted. The substance which is called the medullary process, is clearly seen to spring from the bark, and to terminate at the line of its first union with the stock.

An examinrtion of the manner in which wounds in trees become covered, (for, properly speaking, they never can be said to heal,) affords further proof, were it wanted, that the medullary processes, (as they are improperly named,) like every other part of the wood, are generated by the bark.

Whenever the surface of the alburnum is exposed but for a few hours to the air, though no portion of it be destroyed, vegetation on that surface for ever ceases. But new bark is gradually protruded from the sides of the wound, and by this new wood is generated. In this wood, the medullary processes are distinctly seen to take

their

their origin from the bark, and to terminate on the lifeless surface of the old wood within the wound. These facts incontestibly prove, that the medullary processes, which in my former Paper I call the silver grain, do not diverge from the medulla, but that they are formed in lines converging from the bark to the medulla, and that they have no connection whatever with the latter substance. And surely nothing but the fascinating love of a favourite system could have induced any naturalist to believe the hardest, the most solid, and most durable part of the wood, to be composed of the soft, cellular, and perishable substance of the medulla.

In my last Paper, I have supposed that the sap acquired the power to generate wood in the leaf; and I have subsequently found no reason to retract that opinion. But the experiment in which wood was generated in the leaf-stalk, apparently by the sap descended from the bark of the graft, induces me to believe, that the descending fluid undergoes some further changes in the bark, possibly by discharging some of its component part through the pores described and figured by MALPIGHI.

I also suspected, since my former Paper was written, that the young bark, in common with the leaf, possessed a power, in proportion to the surface it exposes to the air and light, of preparing the sap to generate new wood; for I found that a very minute quantity of wood was deposited by the bark, where it had not any apparent connection with the leaves. Having made two incisions through the bark round annual shoots of the apple-tree, I entirely removed the bark between the incisions, and I repeated the same operation at a little distance below, leaving a small portion of bark unconnected with that above and beneath it. By this bark, a very minute quantity

quantity of wood, in many instances, appeared to be generated, at its lower extremity. The buds in the insulated bark were sometimes suffered to remain, and in other instances were taken away; but these, unless they vegetated, did not at all affect the result of the experiment. I could therefore account for the formation of wood, in this case, only by supposing the bark to possess in some degree, in common with the leaf, the power to produce the necessary changes in the descending sap; or that some matter originally derived from the leaves, was previously deposited in the bark: or that a portion of sap had passed the narrow space above, from which the bark had been removed, through the wood. Repeating the experiment, I left a much greater length of bark between the intersections; but no more wood than in the former instances was generated. I therefore concluded, that a small quantity of sap must have found its way through the wood, from the leaves above; and I found, that when the upper incisions were made at ten or twelve lines distance, instead of one or two, and the bark between them, as in the former experiments, was removed, no wood was generated by the insulated bark.

I shall conclude my Paper with a few remarks on the formation of buds, in tuberous rooted plants, beneath the ground. They must, if my theory be well founded, be formed of matter which has descended from the leaves through the bark. I shall confine my observations to the potatoe. Having raised some plants of this kind in a situation well adapted to my purpose, I waited till the tubers were about half grown; and I then commenced my experiment by carefully intersecting, with a sharp knife, the runners which connect the tubers with the parent plant, and immersing each end of the runners, thus intersected, in a decoction of logwood. At the end of

of twenty-four hours, I examined the state of the experiment; and I found that the decoction had passed along the runners in each direction; but I could not discover that it had entered any of the vessels of the parent plant. This result I had anticipated; because I concluded, that the matter by which the growing tuber is fed, must descend from the leaves through the bark; and experience had long before taught me, that the bark would not absorb coloured infusions. I now endeavoured to trace the progress of the infusion in the opposite direction; and my success here much exceeded my hopes.

A section of the potatoe presents four distinct substances: the internal part, which, from the mode of its formation and subsequent office, I conceive to be allied to the alburnum of ligneous plants; the bark which surrounds this substance; the true skin of the plant, and the epidermis. Making transverse sections of the tubers which had been the subjects of the experiments, I found that the coloured infusion had passed through an elaborate series of vessels between the cortical and alburnous substances, and that many minute ramifications of these vessels approached the external skin at the base of the buds, to which, as to every other part of the growing tuber, I conclude they convey nourishment.

Some other experiments were made on this plant, which appeared to me interesting; but my Paper has already a good deal exceeded its intended limits. I will therefore dismiss the subject; but intend to trouble you with another Memoir in the autumn, should this be honoured with the approbation of the Royal Society.

Memoir on the refining of Lead, containing Reflections on the Inconveniencies of Cupels made with Ashes, and Description of a new economical Method of constructing Cupels or Basins for Refining. Read to the National Institute. By M. DUHAMEL, a Member of the Institute, and Inspector of Mines.

From the JOURNAL DES MINES.

IT is generally known, that to separate silver from lead a metallurgic process has always been employed, called refining or cupellation, which is performed in a basin, denominated a cupel. It is equally well known that this basin is formed either with the ashes of the bones of animals, or with those of vegetables, after having been lixiviated, to deprive them of the saline particles they contain.

The great quantity of wood-ashes necessary for the construction of cupels, and the difficulty of procuring them, have long induced me to seek a more simple, and less expensive, method of forming the basins in question.

The ancient chemists having observed that lead becomes oxydated, or is reduced to the substance called litharge, when exposed to heat, and to the contact of the atmospheric air, while the silver which is combined with it retains its metallic form, the only point that remained for them to discover was a method of effecting the separation of those two metals. To this discovery they were led by observing that the oxyd of lead, in a state of liquefaction, easily penetrates substances that happen to be in contact with it, particularly into the ashes of the bones of animals, without destroying the figure of the vessels constructed

constructed with them. No other material is so proper for the formation of small cupels for experiments.

The difficulty, and frequently the impossibility of procuring six or eight hectolitres * of bone ashes for each operation on a large scale, in the German furnaces, has caused recourse to be had to wood-ashes. But independent of the expense, and the difficulty of obtaining a sufficient quantity even of these, they are attended with a great disadvantage of being carried away, and floating on the surface of the lead, which renders that operation useless. This takes place whenever the ashes are not well prepared, when the cupel is improperly or unequally formed, or the channels intended for the evaporation of the moisture are neither sufficiently numerous nor suitably arranged, nor covered with a layer of scoria, upon which is placed the bed for the reception of the ashes; this bed should be constructed of the most porous bricks, that the water, with which it is necessary to wet the ashes, may penetrate through them as it evaporates, filtre through the layer of scoria, and run off by means of channels at the bottom of the furnace.

To ascertain the quantity of lead in silver, it is sufficient to put a few grammes into a small cupel of bone-ashes, placed beneath the muffle of an assaying-furnace; as the lead becomes oxydated it sinks into the cupel, and at length becomes incandescent, which shews that all the lead is dissipated, that the silver it contained is refined, and has attained the highest degree of purity.

In refining upon a large scale, the object likewise is to separate the silver from the lead, but not to make the whole of the latter penetrate into the cupel, which indeed is impracticable; because, in that case, a much greater

* A hectolitre is about one hundred quarts English measure.

quantity of ashes would be required for the total absorption of the metal; otherwise the operation would take ten times the usual space of time allowed for each refining, would occasion a tenfold expense in fuel, and a much greater loss in the metals than by the ordinary process, by which the greater part of the lead is obtained in litharge, while a portion penetrates into the cupel, and absorbs about five centimetres of its thickness. This must again be melted, to separate it from the ashes, which reduction is likewise more expensive, and subject to a greater loss than the litharge, which melts with ease, and is fit for the purposes of commerce without again passing through the furnace.

Lead ores and litharge may be melted as in England and the departments of ci-devant Bretagne, in a reverberatory furnace, the beds or basins of which are formed of clay, pounded and moistened. These beds resist the action of the heat and the oxyd of lead during an incessant employment of six or eight months.

The durability of these clay-beds gave me the first idea of the method, which I shall presently propose, for refining-furnaces, where it is required only to oxydate the lead to obtain the metal in litharge, and not to cause the whole of it to be imbibed in the cupels, as is the case in assaying the metal to ascertain what quantity of silver it contains. In the operation on a large scale, the cupel, though of ashes, absorbs only a part of the lead, as I have already stated, when shewing that it would be much more profitable to obtain the whole transformed into litharge, the reduction of which into lead is infinitely easier than that of the oxyd contained in the ashes, which render the fusion more difficult, and whose scoria always contain a proportion of metal.

In

In a cupel of ashes formed in an iron oval, the largest diameter of which is fourteen or fifteen decimetres, (4½ to 5 feet,) and the smallest one metre (something more than a yard), the English refine 1000 or 1,200 myriagrammes (10 to 12 ton) of lead, which is converted into excellent litharge, excepting the small portion that penetrates into the cupel, about seven centimetres only in thickness, and supported by two bars of iron beneath the arch of the furnace. A pair of bellows drives the litharge to the fore part of the furnace, from which it falls without interruption upon the floor of the foundery. To fill up the vacancy occasioned by the running off of the oxyd, a bar of lead is gradually moved within the furnace, which as it melts, keeps the cupel full till the conclusion of the operation.

In giving this brief sketch of the English method of procedure, I only wish to shew that it is possible to perform the operation of refining with cupels formed with a small quantity of ashes: those above-mentioned absorb less than 40 kilogrammes (about 90 lbs.) of oxyd, out of the vast quantity of lead refined in them.

Thus it is clear that metallurgists have always endeavoured to obtain the greatest quantity possible of litharge, and a small proportion of ashes impregnated with oxyd, but not daring to depart from the accustomed process, they continued to form their cupels invariably of ashes.

We have seen that in cupellation, on a small scale, the lead, as it becomes oxydated, penetrates the ashes; when no more remains, a small globule of pure silver of a spherical figure is left at the bottom of the basin. This operation is performed with the greater expedition, as in these small vessels the surface of the basin is always raised in the middle, and consequently the oxyd runs off as if upon an inclined plane to the sides of the cupel, where it is instantly absorbed.

This

This is not the case with large cupels, several metres in diameter; in these it is necessary to employ bellows, which not only accelerate the oxydation, but likewise drive the litharge towards the channel made for it to run off.

The inconveniencies, and even the impossibility of making all the lead penetrate into the ashes of large cupels, have already been remarked. Indeed, the oxydation is effected only in that part of the basin exposed to the contact of the air and the wind of the bellows; otherwise the litharge in the middle of the basin, being unable to reach its sides, would remain stagnant, and would consequently oppose the formation of a new layer of oxyd.

This induced metallurgists to drive off this litharge by means of bellows, as fast as it was formed, and to make it run off out of the furnace.

Thus the oxydation takes place only on the surface of the basin, and not towards the bottom; if it were otherwise, the ashes of the cupel would be penetrated to a more unequal depth, in proportion to the length of the operation. On the contrary, I have always observed that the *test* or that portion of the ashes which is absorbed, is not thicker at the centre of the basin than at its circumference, though the lead remains 30 or 40 times as long at the bottom as at the sides, for the melted metal is continually diminishing till all the lead is reduced to litharge, and there remains only the globule of silver at the bottom of the cupel.

If all the lead is absorbed by a cupel for assaying, it is because this small vessel is exposed to an equal heat in every part. A large cupel presenting only its upper surface to the action of the caloric, the oxyd absorbed ceases to penetrate to the point, where the heat is no longer capable

pable of keeping it in fusion; this is the reason why the depth impregnated with it is equal throughout the whole cupel, and from the same cause all the lead cannot be made to penetrate into the ashes.

According to the above observations, it is easy to judge, that if the assay of lead ought to be made in small cupels of bone-ashes, in order that all the oxydated metal may penetrate into and be partly converted into vapor, a contrary method should be adopted with regard to refining on a large scale, when the principal aim should be to accelerate the operation, and to obtain as great a quantity of litharge as possible.

I have already stated that the wood-ashes, of which the cupels are made for operations on a large scale, are expensive, and frequently cannot be obtained in sufficient quantity; that they are, moreover, liable to be injured and even totally destroyed, which is attended with considerable loss. I have to add that, in order to give more weight and consistence to cupels, it is often found necessary to mix with the ashes a considerable quantity of sand, especially if the lead contain any foreign substances, as arsenic, cobalt, antimony, tin, &c. If the lead contain nothing but arsenic, after taking off the first scum, about ten kilogrammes of iron filings should be scattered from time to time over the whole surface of the liquid metal. This iron being lighter than the lead, floats upon it, and absorbs the arsenic, after which it is taken off. Soon after the litharge is formed without any impediment. This method is employed in Saxony.

The necessity of adding sand to the ashes of cupels might have led to the discovery of the method which I propose.

New

New construction of basins for refining.

Without altering the body of the masonry work of the so called German furnaces for refining, care must only be taken to form at the bottom of them a sufficient number of channels for the evaporation of humidity, and to place them in the most proper manner for obtaining this effect. These channels should be covered with a layer of scoria, upon which should be laid a pavement of the most porous bricks, only one brick in thickness.

On this area which should be concave like the bed, on which are piled the ashes of common cupels, lay sand, wetted a little, and if it be not sufficiently tenacious, add one-fifteenth part of clay to give it the necessary solidity, and mix the whole carefully together. This sand must be pounded in the same manner as ashes, for the purpose of consolidating it, and formed into a basin, for refining of equal thickness in every part. The thickness of this cupel should be 15 or 16 centimetres; and it may be made of two layers as we shall presently see.

After the basin has been uniformly pounded in every part, shake through a sieve over its whole surface 2 or 3 litres of lixiviated wood-ashes, which must be made to adhere by means of the pestles.

The cupel being thus prepared, lower the cover of the furnace, and make in the grate a moderate fire, which must be kept up several hours to produce the evaporation of part of the water with which the sand has been wetted; the surplus will be dissipated without inconvenience, by means of the channels for evaporation during the refining.

When sufficiently dry, raise the cover of the furnace, suffer the cupel to cool a little, cover it with straw or hay, then arrange the bars or pigs of lead, laying them down

down gently that their weight may not make any impression upon the sand; it is to prevent this depression that straw should be put, as is the practice in cupels of ashes *.

After the quantity of lead required to fill the cupel is arranged in the furnace, let down the cover, lute it all round with hardened clay, then make a fire as in the usual process of refining.

When the lead is in perfect fusion and covered with scum and carbonified straw, this scum or dross should be removed in the way of litharge, by means of a piece of board about three decimetres in length, in the middle of which must be fixed an iron rod of sufficient length to reach across the furnace, about a yard at most.

After the lead has been well scummed several times and begins to turn red, let the bellows begin to act, but only gently at first. Their nozzles should be placed in such a manner, that the wind from both should be directed to the centre of the cupel; and that this wind may always be carried to the liquid metal, a small round iron plate should be fixed to the end of each nozzle. These suckers are employed in German furnaces for refining, being suspended by hinges from the top; each puff of the bellows turns them half round, and they repel the air towards the metal, thus accelerating the oxydation.

When all the scum is taken off and the lead has become red, and is covered with a layer of litharge, with the small iron hook for that purpose, make a hole in the sand of the cupel, level with the surface of the metal, hollowing it gradually and with care; then the

* Instead of bars it is more adviseable to cast the lead in semispherical iron pots, as in that form it would be less liable to injure the cupel.

litharge driven by the wind to the front of the furnace will run off through this channel, and fall upon the area of the foundery as in the common process of refining.

When the refiner perceives that very little lead is left near the hole, he must close it up with some wet ashes, but as soon as the lead is covered afresh with oxyd, the channel must be again opened according to the height of the metal, taking care to suffer no lead to escape, especially towards the end of the operation, as it might carry with it a considerable quantity of silver which would be lost. In this manner proceed till the silver has become incandescent, observing to augment the fire in proportion to the diminution of the metal, more particularly when the operation is nearly finished, because then the silver is collected together; and as it is more difficult to be kept in fusion than the small quantity of lead which remains united with it, it could be but very imperfectly separated with an insufficient degree of heat; and instead of about one-twentieth of lead, which silver usually retains in the German process, it would have a much more considerable quantity, which would render it much more difficult to pass to the second operation called the refining of the silver, whereby it is brought to any degree of purity that is required.

Those who are accustomed to refine lead in the German method will be able to do it by the method that I propose; for though the cupel is of sand instead of ashes, the operation must be performed in the same manner.

We have seen that the English refine a great quantity of lead in a small cupel, and a great quantity of that metal may be passed through that which I propose, by adding more in proportion as the oxydated lead is driven off.

Supposing

Supposing the cupel to be capable of containing 4 or 500 myriagrammes of lead, above 1600 may be refined by a single operation, without the inconveniences of the English process.

I even flatter myself that a cupel well made with sand will serve for several operations, without being obliged to construct it afresh each time, as in those made of ashes; but in this case the hole or channel, previously made for the litharge to run off, must be filled with sand after removing with a chisel a kind of varnish which the oxyd leaves upon the sides of this channel; that the fresh sand made rather damp may unite with the old, which it will likewise be necessary to wet around that part.

The durability of beds of earth in reverberatory furnaces, where lead ores and even litharges are melted, as I have stated above, will remove all apprehension relative to the action of the oxyd of the lead, which will affect only the surface of the cupel, and will penetrate it but to a very small depth.

After one or more operations this crust may be removed, and fused in a hand-furnace to separate the lead from it; a process which will be as easy as the reduction of the metal contained in the ashes of ordinary cupels, and in much less quantity. Thus more lead will be obtained by the new than by the old method, which will be an advantage, as I have before observed. I shall add, that as the bottom of the sand does not absorb as much oxyd of lead as that of the ashes, it will not contain as much silver, for it is known that the lead separated from these ashes contains much more of the former metal than that proceeding from the reduction of litharge.

Instead of sand, argillaceous earth may be employed for the construction of the cupels, as is practised for the

beds of the reverberatory furnaces in the province of Bretagne; but this earth ought to be pounded several days successively, otherwise it would be liable to crack; and these cracks would continually increase in consequence of the shrinking caused by the caloric; the lead would insinuate itself into these clefts, an inconvenience which cannot take place with sand even if somewhat earthy. I must still observe, that a cupel of earth would grow too hard to permit the formation of a channel for the litharge; in this case the place where the oxyd is to run off should be made of sand or lixiviated ashes.

I shall add, that it will be advantageous to employ two kinds of sand to form the basin of the cupel, the one fine, like that for moulding, the other coarser, and not earthy; the first layer should be made of the latter, about eight centimetres in thickness, after it has been well pounded with pestles for the purpose. Upon this first bed lay the fine sand, somewhat earthy, which will form the second, and must be pounded like the former; both these beds should be wetted a little before they are removed to the furnace, that they may the better combine, and be consolidated by the pestles.

The sand of the lower bed being coarser than that of the upper will absorb its humidity as it drains off, and will suffer it to pass without impediment into the channels made for that purpose.

The lower bed of sand may be left when a fresh cupel is to be made with fine sand, and that portion of the latter which has not been impregnated with oxyd must be mixed afresh, for the construction of the cupel. Attention must be paid when taking away this sand not to meddle with the lower bed, as the coarse sand of the latter

...d with the other. This in- spreading upon the bed ...f ashes, where the opera- ...ng the fine sand of the up-

... that the moulding sand should be ...d that, if it be not, it is necessary to ...ity of clay to give it adhesion; but as be equally distributed through every part ... it should be diluted in the water used for ... sand, and the whole ought then to be mixed ...ate.

... may be objected, that as the cupels of sand do not ...orb as much litharge as those of ashes, more time would be required to perform the operation, since, in the new process, the oxyd instead of being absorbed is carried off out of the furnace. On this head no apprehension need be entertained, for the wind of the bellows, when properly directed, will make the litharge run off by the channel more abundantly than if absorption took place.

I have seen refiners in Germany who construct their cupels with ashes, and practise the judicious method of forming in the middle a small circular hole, the diameter of which is proportioned to the quantity of silver they know to be contained in the lead of one operation. By means of this disposition, no grains of that precious metal remain separate from the lump; the whole is collected in the basin in the centre, and forms a perfectly round cake. I recommend the same practice in the construction of cupels of sand.

I am convinced that the cupels which I propose, if made with care and judgment, will be found to succeed perfectly

perfectly well, and that they will be very economical without possessing the inconveniencies of those made of ashes. For the advantage of metallurgy, I am axious that the method pointed out in this memoir should be put in practice; it will prove that we ought not always blindly to follow old customs, or the routine of workmen.

On the different Combinations of Cobalt with Oxygen; with Observations on various ammoniaco-metallic Salts.

By M. THENARD.

Extracted by M. Drappier.

From the JOURNAL DES MINES.

IT has been long known, and especially since the memoir of M. Tessaert, inserted in the Annales de Chimie *, that if an alkali be poured into a solution of cobalt, a precipitate is obtained at first of a laylock colour; that with excess of alkali this precipitate becomes successively blue and olive; that it grows brown by desiccation, and at length turns black. These phenomena had been before attributed to the influence of the air; but M. Thenard, whose accuracy is well known, has ascertained, by experiments, that the absorption of oxygen, which had till then been only suspected, is the real cause of it. That chemist, by examining the action of the air, with and without the aid of heat and that of oxygenated muriatic acid on olive-coloured oxyd of cobalt, has found that the oxyd first turned to a dark brown, and afterwards

* Vol. XXVIII. p. 84.

to

to a deep black. In both these states the oxyds, prepared with either of the re-agents, possess the following properties.

The black oxyd dissolves with effervescence in muriatic acid; and a considerable quantity of oxygenated muriatic acid is disengaged. In nitric and sulphuric acid the solution is more difficult, and requires a longer time. It is accompanied with bubbles, which M. Thenard presumes to be oxygen gas.

The brown and olive-coloured oxyds produce, with those acids, the same phenomena as black oxyd, with this difference, that their action is less powerful; that of the olive-coloured oxyd being still weaker than the other.

The olive-coloured oxyd is prepared by pouring potash into a solution of cobalt. A blue precipitate is formed, which becomes green by exposure to the air. If this oxyd, while yet damp, be treated with weak muriatic acid, by means of a gentle heat it emits oxygenated muriatic acid; it is therefore evident that it has absorbed the oxygen of the air; but, to remove all doubt on this head, M. Thenard put a quantity of blue oxyd into a bottle, and carefully corked it up; in the space of a few minutes a vacancy appeared, and the air that remained could with difficulty be inflamed.

The same chemist likewise submitted the blue oxyd to the action of those acids, but this oxyd, prepared in the manner above described, is extremely fine, and if it come ever so little into contact with the air it almost instantly turns green: on this account M. Thenard preferred to prepare it by disoxygenating the black oxyd; that is, by submitting it for half an hour to a red heat. M. Tessaert was the first that perceived and described that phenomenon; he attributed it to the presence of a small

small quantity of arsenic, which he suspected to exist in his cobalt, because he could produce it only once, and because he had obtained a light blue, approaching to a violet, by heating arsenious acid with oxyd of cobalt.

The blue oxyd differs from all the others in dissolving in acids without any disengagement of gas; it resembles them in other respects, as the solution of it in concentrated muriatic acid is green, as it passes to a purple by exposure to the air for several hours, and to a rose colour instantly upon the addition of water. This remark furnished the means of explaining why characters made with muriate of cobalt appear of a beautiful pea-green when held to the fire, and disappear when removed from it: the heat concentrates the solution, the characters become apparent, the muriate of cobalt afterwards attracts the humidity of the atmosphere, and they are effaced.

As to the rose-coloured or laylock oxyd, M. Thenard doubts its existence, because he was never able to obtain it by pouring a saliliable basis into a solution of pure cobalt. He thinks that the rose-coloured precipitates obtained with alkalis are no other than arseniate, or some other salt of cobalt. For the rest, "it is possible," says he, "that in these solutions the cobalt may exist in the state of rose-coloured oxyd: at the same time the contrary may be the case; and it would not be the first instance of a metallic solution having a different colour from its oxyd: highly-oxygenated nitrate of mercury is colourless, while the oxyd of that salt is red, &c."

There however exist at least four kinds of oxyd of cobalt; blue, olive, brown, and black oxyd: according to M. Thenard, the brown oxyd may possibly be a mixture of olive and black oxyd: but the want of materials prevented him from removing all his doubts, and from rendering his researches as complete as he could have wished.

wished. His investigations of the different combinations of cobalt with oxygen have, however, led to the following observations.

Desirous of purifying cobalt containing iron, he treated it with nitric acid, and poured into the solution an excess of ammoniac. After having filtered and evaporated the liquor to dryness, he treated the residue with water, and separated the fresh oxyd from it by the filtre. The water contained not only nitrate of ammoniac, but likewise cobalt: when subjected to evaporation, as it became cool, it deposited a salt, in rose-coloured crystals, of a cubic form, of a pungent taste, resembling urine, inalterable in the air, entirely decomposable by fire, emitting a lively pale yellow flame, and leaving a black residue, possessing all the properties of oxyd of cobalt; their solution yields no precipitate with any salifiable substance, but it affords one with sulphuretted hydrogen and hydro-sulphurets: potash, with the assistance of heat, disengages ammoniac, and precipitates oxyd from it. This salt is evidently an ammoniacal nitrate of cobalt.

Nickel, submitted to the same experiments, afforded the same results, with this difference, that the colour of the triple salt was green, and that the form of the crystals was not so perfect.

Oxyd of zinc, heated to ebullition with muriate of ammoniac, likewise yields a triple combination; in this case a small quantity of ammoniac is disengaged. As this salt dissolves a much greater proportion of oxyd of zinc hot than cold, a considerable part is precipitated, either as it cools or by the addition of cold water. When this solution has become cold, provided too great a quantity of decomposed muriate of ammoniac has not been employed, it gives no precipitate, either with alkalis or even alkaline carbonates: it yields a white precipitate, with sul-

sulphuretted hydrogen and hydro-sulphurets, but does not crystallize.

In the same manner an ammoniacal muriate of lead may be obtained by treating oxyd of lead with muriate of ammoniac, or by pouring muriate of lead into muriate of ammoniac. If, to ascertain the combination, sulphuric acid be poured into the mixture, no precipitate is obtained, while alkaline carbonate produces one immediately.

Highly-oxygenated muriate of tin, which, under other circumstances, is known to be insoluble in nitric acid, when treated with this acid and ammoniac yields a solution of tin. This fact has served to explain why nitric acid, employed to act upon tin, furnishes, by evaporation, a salt containing a great quantity of oxyd: the solution is then promoted by the ammoniac produced, as M. Guyton has proved, during the action of the nitric acid upon the metal.

According to these experiments of M. Thenard, ammoniac is capable of forming triple salts with the oxyds of cobalt, nickel, zinc, lead, and tin. According to the discoveries of other French chemists, it forms magnesia and soda with the oxyds of platina, silver, copper, mercury, and with alum. Potash appears to be the alkali which has the greatest tendency next to ammoniac to produce a triple combination: and we know this is the case with the oxyds of platina, antimony, tungsten, alumine, and soda.

It therefore appears natural to conclude, from these observations, that in chemical analyses the operator should be perfectly familiar with the use of potash, and especially of ammoniac; that, to prevent falling into great errors, he ought to take the utmost care that a triple salt may not be formed, when precipitating any sub-

stance

stance from a solution with the intention of weighing it. We may likewise add, that soda not being liable, at least as far as we know, to so many of these triple combinations, ought to be preferred in many cases to the two above mentioned alkalis, as its purification is not attended with greater difficulty than that of potash, and as its carbonate may be obtained in a pure state even with greater facility. Be this as it may, M. Vauquelin has made us acquainted * with a combination of soda and phosphate of lead; it would be of utility to enter into a comparative examination of the action of this alkali upon earthy and metallic salts.

Memoir which obtained the Prize, proposed by the National Institute of France, on the Question, "To point out the Earthy Substances, and the Processes necessary for manufacturing Earthen-ware, capable of resisting sudden Transitions from Heat to Cold, and cheap enough for general Use." By M. FOURMY.

From the JOURNAL DES MINES.

(Concluded from Page 149.)

Of the Composition of common Earthen-ware.

EVERY one knows that *clay* is the substance employed for common wares. That name is given to a kind of earths, more or less ductile, to which caloric imparts a greater or less degree of solidity.

These earths are mixtures more or less complicated; the properties of which vary according to the proportions, forms, and volume of their component parts, that is, *ad infinitum;*

* Journal des Mines, Messidor, year 8.

infinitum; so that no two can be found in every respect alike. Those most generally employed in the composition of common wares contain alumine, silex, frequently lime, almost always oxyds or sulphur of iron; we likewise find in them magnesia, barytes, and other earths, better known in the laboratory of the chemist than in the work-shop of the manufacturer; salts, animal and vegetable matters, carbon, gases, &c. &c.

Alumine and silex are, if I may so express myself, the only calculated parts; the others are seldom noticed, though their functious are not altogether indifferent. The reason of this is, that their influence is only secondary, while that of the two former is absolutely decisive. Thus setting aside the accessory substances, it may be said that the common wares are composed of an earthy mixture, whose fundamental parts are alumine and silex. The proportion is sometimes natural, but is more frequently fixed by the manufacturer, according as it suits his purposes.

These purposes must, indeed, always be subordinate to certain principles; but the application of these principles cannot be submitted to any invariable rule, because the results depend not only on the nature of the substances, or of the proportions in which they are combined, but likewise on the form and volume of the particles composing these substances, and particularly on the temperature employed.

The different kinds of baked earths manufactured at Paris are almost all composed of the same substances; yet they differ considerably both in their organisation and in their properties, because the cements which form a part of them, being more or less voluminous and abundant, modify their texture, *ad infinitum*; and because the difference between the degrees of heat employed in baking

[redacted]

baking them produces very great varieties in the combination of their particles.

The only general remarks that can be hazarded on the composition of the wares under consideration, may, therefore, be reduced to a very small number of general principles.

The earthy mixture employed in forming the biscuit of a ware intended to endure, *without precaution*, the alternatives of heat and cold, should unite four essential conditions; these are:

1. It should contain a sufficient quantity of alumine, and consequently be sufficiently ductile to be worked at a small expence.

2. It should contain a sufficient quantity of silex, and consequently be sufficiently soft to allow a free passage to the particles of caloric.

3. It should be sufficiently fusible to acquire the necessary degree of solidity with a moderate heat.

4. It should be sufficiently refractory to endure without alteration the heat requisite for fusing the varnish.

If too aluminous, it would acquire too close a texture, and would with difficulty be brought to take a covering.

If too silicious, it would want solidity.

If too fusible, its form would be injured by the heat necessary for the fusion of the varnish.

If too refractory, the expence of the combustible requisite for baking it would augment the price of the wares too much.

Experience alone can teach the proper medium.

Of the Composition of common Stone-ware.

Stone-wares differ from common earthen-ware in the closeness of their texture, which proceeds from the superior fineness of the clay and the violence of the heat to which they

they are exposed in baking. Their denseness varies according to the greater or less prevalence of these two causes; but it is generally such, that their fracture is smooth, like that of porcelain, and, like the silices, they strike fire with a steel: it is by this property that they are in a particular manner distinguished. In this state they cannot resist sudden transitions from heat to cold; but the farther they are from it the less capable they become of enduring those transitions, and then resemble common earthen wares so much as to be sometimes mistaken for them.

All the productions of the stone manufactories are generally called by the name of stone wares, though among the number there are some which have scarcely any more density than common earthen wares, or perhaps none at all, and which, on this account, are capable of enduring the alternatives of heat and cold; so that it is not uncommon to hear of *stone that stands the fire.*

But those acquainted with the subject confine the term of stone to a very hard kind of ware, the fracture of which bears a greater or less resemblance to that of glass, and which strikes fire with steel. Is is evident that such a substance is incapable of enduring sudden transitions from heat to cold.

It is, therefore, strictly correct to say, in general, that stone cannot stand the fire. If some of the wares, known by that name, possess this advantage, it is because they vary from the kind of manufacture to which it ought exclusively to be confined.

Stone-wares are either varnished or not varnished; some of the former (which alone we shall here notice) receive a certain varnish by means of the vapor of the muriate of soda; these belong to the class of those mentioned above, under the head of natural varnishes.

There

There are others to which artificial varnishes are applied; these varnishes are most frequently earthy, because the temperature necessary for baking the biscuit being sufficiently high for the fusion of substances purely earthy, the manufacturer can have no interest in employing either lead or salts.

Of the Composition of an Earthen-ware possessing the three Qualities which are the Object of the Question.

None of our (the French) earthen-wares at present combine these three qualities; to obtain them, we must therefore proceed in a manner different from what we have hitherto done. We shall succeed by two methods; either by forming new mixtures, or by modifying those already in use. The former would be more brilliant, without in reality possessing greater merit. The latter, being an application more easily attainable, will be so much the more advantageous. Thus, it would be useless to create; it is sufficient to improve what exists, that is, to give the compositions with which we are already acquainted the qualities they want.

Supposing we have, 1, a kind of earthen-ware capable of resisting sudden transitions from heat to cold, and at a low price, but the varnish of which contains oxyds prejudicial to health; if, without depriving it of the two qualities it possesses, we can make it take a wholesome varnish, we shall attain the desired object.

Supposing we have, 2, another kind free from unwholesome oxyds, but incapable of resisting sudden transitions from heat to cold; if without injuring the two properties it combines, we can add that which it wants, we shall likewise obtain a satisfactory solution of the question.

In

In the first case it is the varnish, and in the second the texture that must be altered. Instead, therefore, of proposing innovations that would be attended with a greater or less degree of embarrassment to those who might be desirous of manufacturing wholesome earthen ware, I thought it more advisable to make experiments with substances already employed, and only to introduce into the usual processes such modifications as may be easily adopted in the manufactories already established.

For this purpose I took two kinds of ware, well known at Paris, each of which is in one of the cases above mentioned; the common earthen-ware of Paris being in the first, and the common stone-ware of Beauvais in the second.

Of the common Earthen-ware of Paris.

The substances proper for the manufacture of earthen-ware of a finer or coarser quality, are very abundant in the neighbourhood of Paris. The principal of these are:

No. 1, a clay of a blueish-grey colour, very fine and ductile, mixed with a great quantity of sulphur of iron. It is found at the depth of several metres below the surface of the earth; to reach it, you are obliged to penetrate through a bed of calcareous tuf, which forms the stone for building at Paris. It is dug at Arcueil, Gentilly, la Glaciére, Vaugirard, Vanvres, and Yssy.

Not only in the different pits but even in the several strata in the same pit, appear variations resulting less from the nature of its component parts than from the state and the proportions in which these parts exist; the most important of which variations consist in the more or less advanced decomposition of the sulphurs.

When purified from these sulphurs, it is proper for manufacturing not only common earthen-ware, but likewise stone-ware, of excellent quality.

A sample

A sample of this clay, taken at Vanvres, when analysed, presented,

No. 1.	Alumine	32,25	100
	Silex	63,5	
	Lime	,25	
	Iron	3,75	
	Loss	,25	

No. 2, a clay of a greenish colour, less fine and ductile than the preceding: it is found at Montmartre, Belleville, Menil Montant, &c. Almost all the hills round Paris, to the distance of several kilometres, are covered with it.

A sample of this clay from Montmartre presented the following result:

No. 2.	Alumine	19	100
	Silex	66,25	
	Lime	7,5	
	Iron	6,75	
	Loss	,5	

No. 3, a marl of a light yellow, sometimes approaching a blue-grey, and possessing almost the consistence of stone. It appears in strata of no great thickness above beds of lime-stone, and beneath the green clay above mentioned.

A sample of this marl from Menil Montant gave,

No. 3.	Alumine	8,25	100
	Silex	17,5	
	Lime	66,	
	Iron	,5	
	Evaporated Water	7,5	
	Loss	,25	

No. 4, a kind of fine sand, somewhat earthy, and of the colour of sulphur. The greatest part of it is procured at Picpus; but it is found in various other places, especially in and near Pologne.

A specimen, taken from the vicinity of Pologne, on the road which forms a prolongation of the Rue Miromenal, yielded,

No. 4.	Alumine	1,5	100
	Silex	72,5	
	Lime	24,5	
	Iron	,75	
	Loss	,75	

No. 5, a sand of a yellow ochry colour, found on the surface of the earth in the canton of Belleville, and places adjacent.

The analysis of a sample of this sand afforded,

No. 5.	Alumine	2,	100
	Silex	97,	
	Lime	,25	
	Iron	,75	

Of these five substances, the first and the last are almost the only ones employed in the composition of common earthen-ware, the others being used for other purposes, as for bricks, tiles, &c. The potters usually employ one or two parts of the clay, No. 1, to which they add one part of the sand No. 5. Their wares are in consequence extremely weak, and therefore capable of sustaining the alternatives of heat and cold, but frequently so porous that grease or liquids are absorbed, and penetrate through them.

These utensils, besides being incapable of solidity, have two other very material defects; that of communicating

a very

[redacted]

a very disagreeable taste and smell to victuals prepared in them, and that of being covered with a very unwholesome varnish. Both these defects proceed from the same cause, too little baking.

When earthen-ware is not sufficiently baked, several inconveniences result from it.

1. The earthy mixture composing the biscuit does not acquire sufficient solidity.

2. The fermentable substances, which this mixture invariably contains, are not perfectly destroyed or decomposed; they preserve a principle of action which they exercise upon the substances put into the vessels, and these receive more or less injury from it.

3. The saline or metallic composition forming the varnish is not completely vitrified; acids and fatty substances dissolve it more or less easily.

Complete baking alone can correct these two imperfections; and for this purpose a more powerful degree of heat is absolutely required than is usual in the potteries of Paris.

Of the Stone-wares of Beauvais.

The earths of which these stone-wares are composed are procured from various pits in a space of considerable extent from the neighbourhood of Savigny to Neufchâtel en Bray, in the department of the Lower Seine. It is used not only in the manufactories of the country, but exported to distant provinces by the name of Earth of Forges, because the canton of Forges furnishes it in the greatest quantity.

A sample of this kind of clay presented, when analysed,

No. 6.	Alumine	16,	100
	Silex	63,	
	Lime	1,	
	Iron	8,	
	Evaporated Water	10,	
	Loss	2,	

The country abounds in various kinds of sand capable, by their mixture with these clays, of forming compositions of greater or less strength, according to the magnitude of their particles, and the proportions in which they are combined.

A sample of one of these kinds of sand, taken from a hill on the road from Savigny to St. Samson, yielded, by analysis, the following results,

No. 7.	Alumine	1,	100
	Silex	96,	
	Lime	1,5	
	Iron	,75	
	Loss	,75	

The sand and the earth, No. 6, were the materials employed for my experiments Nos. 2, 3, and 4, of which I shall presently speak.

The stone-wares made in the neighbourhood of Beauvais are principally carried to Paris; they have all the qualities, both good and bad, of the common stone-wares. In the manufactories nearest to Beauvais, that is, in the neighbourhood of Savigny, St. Sampson, &c. no varnished stone-ware is made, but only at Martin Camp, a village not far from Neufchâtel en Bray. But as the substances, processes, and productions are the same, with the exception of the varnish, all these manufactures must be ranked in the same class.

Of

Of the Alterations required by the two above-mentioned Kinds of Wares.

The great demand for Paris earthen-ware, as well as that of Savigny, leaves no room to doubt that their price is proportionably low. The former wants only a wholesome varnish, and the latter a weaker texture, to combine the three conditions which are the object of this question.

It was required to ascertain, 1, Whether, with the substances composing the biscuit of the potteries of Paris, another biscuit may be formed capable of receiving a wholesome varnish.

2. Whether the substances composing the stone-ware of the neighbourhood of Beauvais can be modified so as to form another biscuit capable of withstanding sudden transitions from heat to cold.

3. Whether the alterations necessary for producing the desired effect on these biscuits occasion a considerable or too great an increase of price.

For this purpose I prepared four kinds of biscuit, which attain the object required, each in a different manner, on account of the difference of their texture. The first is composed of three parts of Vanvres clay and one part of Belleville sand: the second of one part of Forges clay and one part of very coarse sand of St. Samson: the third of two parts of Forges clay and one part of very fine sand of St. Samson *.

Let us now proceed to examine what kinds of varnish are proper to be applied to them.

* The proportions here specified are not absolutely necessary to be employed; they are only relative to the degrees of heat, and must of course vary with them.

Of

Of earthy Varnishes suitable to common Earthen-wares.

The Chinese, whose industry in this manufacture surpasses that of European nations, make many kinds of wholesome earthen-ware. From the examination which I have been induced to make of them, I am convinced that the earthy varnishes used by them are extremely various.

The potters of Martin Camp varnish their stone-ware with an earth containing alumine, silex, lime, and iron. Those of St. Fargeau, whose stone-ware nearly resembles that of Martin Camp, employ forge-dross, which is no other than glass, likewise containing alumine, silex, lime, and iron.

I have more than one reason for believing that the substances employed by the Chinese are not of the most fusible nature; on this subject, however, I am confined to presumption, while, on the other hand, I know that the substances used at St. Fargeau and Martin Camp require a very elevated temperature.

I conceived that a composition less refractory, and consequently less expensive, with regard to the baking, would be preferable if the wares would not be injured by this economy. This idea led me to a long and expensive investigation of the different substances that appeared likely to fulfil the object in view, that is, to furnish, at a low price, a solid varnish, capable of resisting acids, and impenetrable by greasy substances and liquids.

The limits of this memoir will not admit of my entering into a detail of the experiments which I made, with this view, on the numerous substances offered, more or less gratuitously, by the territory of the republic. I shall therefore confine myself to stating, that I found nothing more suitable than volcanic productions. Among these the

the pumice-stone appeared to deserve the preference, on account of its superior fusibility; but certain kinds of lava very nearly resemble it.

It would be unnecessary to give the analysis of pumice-stones, both because they are so well known, and because the composition of every kind is not the same. All however contain, in greater or less quantity, alumine, silex, lime, and a small quantity of iron, sometimes a very small proportion of magnesia, and other earths.

But whether the kind of vitrification which these mixtures have undergone in the volcanoes has brought them to the same degree of fusibility, or whether it proceeds from some other cause, the differences which appear by their analysis, either in their component principles or in the proportions of those principles, have presented no variations of importance in the results.

I therefore conceive that volcanic productions are perfectly suitable for varnishing wholesome earthen-ware at the cheapest possible rate. Of all the compositions of a purely earthy nature that I have tried, none has produced such a complete fusion at a temperature equally low.

Of the Effect which the proposed Modifications would produce upon the Price.

All the heads of expense incurred in the manufacture of earthen-ware may be reduced to five principal ones.

1. The substances composing the paste or biscuit.
2. The preparation required by those substances to dispose them to receive the moulds.
3. The labour of moulding.
4. The substances of which the varnish is composed.
5. The baking.

Of

Of these, the three first experience, from the proposed modifications, no alteration that can affect the price: the two latter only are capable of producing any variation in the expense.

If we first take, as a medium of comparison, the common earthen-ware of Paris, we shall see that by the new method the heat must be more violent, which would consequently increase the expense in the article of fuel. But we shall likewise find that this increase is counter-balanced by an important diminution in the price of the varnish.

The potters of Paris employ as a flux red oxyd of lead, commonly called *minium*, with which they combine Belleville sand and Vanvres clay; these form a varnish, which stands them in about 60 centimes, *per* kilogramme (somewhat under 3 *d.* *per* lb.) The refuse of pumice-stone, or that which, being too small for the ordinary operations of polishing, is held in low estimation in commerce, is worth at Paris from 30 to 50 c. the kilogramme, or, upon an average 40 c. that is, two-thirds of the price of the varnish used by the potters. This difference arises from the facility of pounding the pumice-stone, the expense of which is very trifling.

But what in an extraordinary degree increases the advantages possessed by this substance is, that being very light, less in quantity by almost one-half is required than of the common varnish: so that, taking every circumstance into the calculation, the varnish which it furnishes costs less by above one-third than that now employed.

Thus this diminution over-balances the increase caused by the elevation of the temperature, and it is incontestible that the proposed alterations will produce a diminution in the expense attending the manufacture of the common

common earthen-ware of Paris. With regard to that made in the neighbourhood of Beauvais, either the employment of the common varnish may be continued, or the pumice-stone may be substituted in its stead. In the first case, the change, as it has been observed above, will be confined to the texture, and cannot affect the price.

In the second case, if on the one hand pumice-stone be dearer than the substances at present employed, as it may happen in certain places; on the other hand it affords the means of abating the temperature, and consequently of diminishing the expense of fuel; if on the contrary it be no dearer, as must be the case in many parts, the diminution resulting from a lower temperature will be clear profit.

Thus taking the subject in the least favourable point of view we have an equality in the expense; but, on the contrary, there is every reason to promise a considerable diminution. In either case it is certain that no other method combines so many advantages.

The Institute will observe that the fruits of the experiments here presented are not the result of a regular system, in which foresights and errors have been corrected; they ought not therefore to be examined with the same strictness as the produce of an established manufacture. Their merit does not consist in the execution, but in the just and enlarged principles upon which they are composed.

I have not merely confined myself to the indication of a receipt capable of fulfilling the three conditions of the question. It was my desire to prove, that with the substances employed in the composition either of the common wares of Paris, or the stone-wares of Beauvais,

other biscuits may be obtained that will resist sudden transitions from heat to cold, and capable of receiving wholesome varnishes.

My attempts leave no uncertainty on this point; the question is therefore resolved as far as regards the biscuits; but the results which I have obtained, and all those which may be obtained, with the substances employed at Paris, and in the neighbourhood of Beauvais, may be produced with all the substances of a similar nature contained in abundance within the territory of the republic. What I have said concerning biscuits is therefore applicable to all the manufactures of earthen-ware in France.

With regard to salubrious varnishes, it is possible there may be circumstances and local situations in which other mixtures, either natural or artificial, would be found more suitable than that which I employed. In places, for example, where fuel is very cheap, it might be advantageous to augment the heat, that the manufacturer may be enabled to use more refractory but less expensive substances than pumice-stone.

I do not pretend to confine the potter invariably to one substance; I only maintain the principle which induced me to select the material in question for the manufactures of Paris, and propose it as an example to which the workman may conform, or from which he may depart at pleasure, according to circumstances, equally impossible to be stated and foreseen.

The essential point is to obtain, at the lowest possible rate, a salubrious varnish, the employment of which is not incompatible with the qualities required in the biscuit. As pumice-stone best answers this purpose in the manufactures of Paris, I have given it the preference; but

but this is no reason for adopting it in places where other substances afford superior advantages. Each manufacturer must employ whatever is most suitable; but the question is nevertheless resolved with regard to the varnish. It has been shewn above, that it was likewise answered with regard to the price. It is therefore resolved as to the three subjects contained in the question.

Conclusion.

The contents of this memoir may be compressed into the following statements:

1. If either the earthy substances employed at Paris, and in the neighbourhood of Beauvais, or others of the same nature, be combined, the manufacturer will obtain biscuits of earthen-ware capable of resisting sudden transitions from cold to heat.

2. Volcanic productions, and especially pumice-stone, will furnish for these biscuits a cheap, solid, and perfectly salubrious varnish.

3. The fusion of this varnish being more easy than that of other earthy varnishes, is accompanied with less expense in baking than the earthy varnishes now in use, and yet the temperature it requires is sufficient for giving the biscuit the necessary solidity, and for purifying it from those substances which, in wares exposed to a low degree of heat, produce a disagreeable taste and smell that cause them to be disliked.

This solution not only far exceeds the limits of the question, but likewise presents two important advantages: in the first place, it is applicable to all manufactories that are or may be established; and, in the second, the improvement may be immediately executed.

 Thus

Thus whenever we please we may banish from all our manufactories the erroneous processes which operate to the detriment of their productions, and with substances derived entirely from the soil of the republic, we may make earthen-ware at the same price, or even cheaper than that now made, which will give neither a disagreeable taste nor smell to victuals, which will be solid and salubrious, and will resist sudden transitions from heat to cold.

Description of a portable Thermometer, adapted to ascertain the Temperature of Wine-Vats, and Dyeing-Coppers, and capable of being applied to various other Uses.

From the Annales des Arts.

WE are indebted to M. Regnier for the invention of several kinds of metallic thermometers, the advantages of which are already acknowledged ; he has likewise turned to account the extreme sensibility with which copper indicates the alterations of temperature. These thermometers are of different forms ; that in general preferred is a tube of the above metal, into the inside of which is introduced a curved piece of iron or steel, the two ends of which are soldered, or otherwise attached to the extremity of the tube ; a pinion, combined with this piece of metal, turns an index on the outside of the tube, the hand of which moves upon a portion of a graduated circle, for the purpose of indicating the contraction or expansion of the thermometer by cold or heat.

M. Regnier, by devoting his attention to the construction of a thermometer adapted to the operations of making wine,

[redacted]

wine, contrived a portable thermometer, which he has presented to the Lyceum of Arts.

The tube and graduation of this instrument are the same as in the common thermometers ; the mounting only exhibits a new arrangement proper for rendering it serviceable in agriculture and the arts.

The cane containing this thermometer is in the whole about a metre (three feet four inches) in length. The socket of this cane is of copper : it forms a long ferrule, which preserves the glass cylinder containing the liquid of the thermometer. The socket is pierced with several small holes, through which the fluid enters when the end of the cane is plunged into it, of course the liquor of the thermometer immediately receives the impression of the caloric, an advantage that is not possessed by the common thermometers for liquids, which are always too slow in their progress.

The iron end of the cane which rests upon the ground is supported at the extremity of the socket by a spring that yields when the end of the cane rests upon hard substances ; and by this contrivance the thermometer is equally preserved from shocks on every kind of ground.

Another spring, placed immediately over the ball of the thermometer, yields when too much weight is borne upon the cane on a pavement, so that the prejudicial effects of every kind of shock or pressure are completely prevented by the disposition of the two springs.

The upper part of this cane is terminated by a ball of cork, covered with Morocco leather ; the elasticity of the cork keeps the thermometer from breaking if the cane be accidentally dropped ; but for the greater security a ribbon or string, to lay hold of, may be added.

In the centre of this cane a cavity is made, in which the tube of the thermometer is fixed, and half of its circumference,

cumference, towards the top, opens with a hinge, for the purpose of making observations when the liquid of the tube is seen, and the scale graduated upon the ordinary principles.

This opening shuts by means of two small hooks fixed in the wood; the thermometer then exhibits the appearance of a cane neatly varnished.

This new contrivance renders the thermometer extremely useful.

1. To ascertain and to compare at a certain depth the temperature of sown land, when the surface is hard frozen.

2. To estimate the heat of hay-stacks which sometimes take fire before the farmer is aware.

3. To compare the heat of garden-beds.

4. To find out the state of fermenting liquors: this thermometer will be the more useful for this purpose, as glass instruments sometimes employed for such observations are liable to break.

5. In the arts, for every kind of operation in which the heat of coppers is regulated to a certain degree.

Independent of objects of utility, this thermometer is an agreeable companion to the observer who, in his country-walks, wishes to ascertain and compare the temperature of different springs and streams, or any other similar purpose; and the convenience of being able to thrust it into various substances without breaking must be considered an additional recommendation.

On

On the Art of hardening Copper.

From the ANNALES DES ARTS.

COPPER in a state of purity and perfection is soft and malleable; its tenacity is so great as to equal that of gold or iron. If copper be hammered cold for a long time, or more especially when it is flatted, it is found to acquire a still greater degree of hardness, but yet it is not capable of resisting violent pressure. If copper be made red-hot and suddenly plunged into water, instead of becoming hard it is rendered more flexible, and consequently softer than before. If copper be kept a long time in fusion, or be frequently melted by a brisk fire, without being covered with a flux or pulverized charcoal, it becomes brittle, unmalleable, and of course harder. But these qualities are corrected when copper is melted in contact with some carbonaceous substance. If melted copper be poured in water, as for the purpose of granulation, it is not, like steel, rendered harder by this operation.

If we reflect on all these facts proved by numerous experiments, we cannot but be astonished at the process employed by the ancients for hardening copper, of which most of their warlike instruments were made; though those implements of death are frequently mentioned by different writers, yet none of them has transmitted to us their method of hardening that metal. We have therefore been confined to conjectures on that subject; it has been conceived that copper could be hardened in the same manner as iron, and the same processes have, therefore, been employed. Their result, however, has only proved the ignorance of the operators of the principles of chemistry.

Thus

Thus the art of hardening copper has been reckoned among those that were known to our ancestors, but are now lost; but various circumstances and particularly researches made in ancient monuments have brought to light various articles, the composition of which has been investigated by analysis. This has shewn that the hardness of copper proceeded by no means from any introduction of charcoal into the mass, but from the mixture of another metal, which by its combination with the copper, augmented its hardness.

Mongez found that the composition of the pieces examined by him very much resembled that of bell-metal; he transmitted to Dizé a fragment of a copper dagger, the fracture of which proved that it was cast and not hammered. A solution of this instrument in nitric acid furnished a white precipitate, which was oxyd of tin; the copper was dissolved: this first experiment proved that the whole art of the ancients consisted in producing a combination of some other metal with the copper. The subsequent experiments of Dizé on Greek, Roman, and Gallic coins confirm this fact, the tin being found in these in the proportion of 24 *per cent.*

M. Hjelm, a Swedish gentleman, has lately turned his attention to this subject. He received of Professor Retzlis, of Lund, a piece of a two-edged dagger, which, together with some stone-cutter's chisels, was found in Sweden, where sabres perfectly entire are often discovered. This fragment was, externally, of a yellowish colour like brass; the edge was blunt; the fracture was granulated, and proved that the instrument had been cast: when tried with a file, this metal seemed by no means so hard as bell-metal, but harder than the brass employed for cannon. The surface of the part submitted to the file was of an orange-red colour, which soon turned to yellow,

yellow, when tried with the blow-pipe, it exhibited no appearance of zinc, but it was easy to perceive that copper formed the principal part of the composition. The filings being exposed to the action of the loadstone were not affected; and as far as could be judged from the vapour disengaged from it when submitted to the blow-pipe, it contained a very small quantity of any other metal.

To discover with what metal the copper was combined, M. Hjelm took twenty-five pounds of the purest filings of the above-mentioned fragment; he heated some nitric acid, diluted with a small quantity of distilled water in a glass retort, and put into it a portion of the filings. When the first quantity was dissolved, the remainder was added by degrees till the dissolution of the whole. He then boiled the solution for a quarter of an hour, and diluted it with a little more distilled water to facilitate the precipitation of a white powder. The blue liquor containing only a solution of copper was decanted, the white precipitate was diluted with distilled water, and afterwards filtered. The powder that remained, on the filtre being dried and weighed, yielded $5\frac{3}{8}$ pounds, or 21 in 100 of oxyd of tin. As this oxyd, upon reduction, loses nearly one-fourth of its weight, these $21\frac{1}{2}$ pounds of oxyd must afford $16\frac{1}{8}$ of tin in a metallic state; this fact has been proved by experiment, and the regulus obtained was perfectly pure. Thus the dagger was composed of $83\frac{7}{8}$ of copper, and $16\frac{1}{8}$ of tin, or, rejecting the fraction, of 84 parts of copper and 16 of tin.

In order to ascertain by experiment the accuracy of this analysis; the blade of a knife was made with the same proportions; it was polished and set in the usual manner. This blade had all the properties and the external appearance of the fragment of the dagger, but

 lost

lost its edge very soon. Another was made with 20 parts of tin, and 80 of copper; the latter was whiter, harder, and more brittle; it broke during the polishing, and was notched with merely cutting a pen.

The degree of brittleness is increased when the proportion of tin is augmented to 25 *per cent.*; the copper-colour disappears, and the mixture becomes white. The same qualities are heightened when the proportion of tin is raised to 30 *per cent.*; which forms an excellent composition for making looking-glasses, spectacles, or telescopes. It is well known that in general the brass for cannon contains 9 *per cent.* and sometimes a greater quantity of alloy more than common brass; it being in the proportion of 16 to 100; for this purpose too, a considerable quantity of zinc is commonly used instead of lead.

What has already been stated is sufficient to confirm the opinion, that the instruments of the Ancients were no other than an alloy. Monnet has supposed that they added arsenic to the copper, but till we find that substance in some fragment that opinion may justly be doubted. Dizé, speaking of the addition of iron to copper with a view to harden it, endeavours to prove that Geoffroy had not maturely considered the subject when he asserted that such a mixture produced a metal as hard as the copper of the Ancients.

If we, however, consider the manner in which Count Caylus relates the experiment, the result is different. Geoffroy undertook these experiments to satisfy the Count, who had observed that the filings of several ancient instruments which he had examined were subject to the attraction of the loadstone. It is certainly extraordinary that at such a remote period the art of combining

copper

copper with iron, a process now considered extremely difficult, should be so well known.

Mineralogists know that the ordinary copper ores contain copper and iron, mineralized by sulphur, which are commonly termed cuperose pyrites; not because copper constitutes the greatest part of them, but because that metal is the most valuable: on the contrary, the principal portion appears to be iron. When this ore is melted, the first copper obtained from it is more or less pure, according to the quantity of iron contained in it; or the greater or less degree of care bestowed upon separating it during the operation. Thus copper may not only be obtained in combination with any quantity of iron that may be thought proper, but all kinds of instruments may be cast with it; these may afterwards be hammered when cold, and after all be submitted to the process of hardening, like pure steel. According to M. Hjelm this method has been tried with complete success.

Without endeavouring to diminish the force of this assertion, which appears extremely probable, we wish that experiments may be made on such a metal, which may easily be procured in the neighbourhood of copper mines. It would be difficult to enumerate all the advantages that would be derived from it for the making of scales, hardware, flatting-machines, cylinders for paper-mills, &c. Perhaps even upon a trial of this substance it might be found a valuable material for artillery; at least if this mixture possess the tenacity of the two metals, we might be enabled to diminish the weight of our cannon without lessening their strength; and we should likewise be relieved from all apprehensions of their bursting, which accident so frequently occurs with alloys of brass.

If we refer to periods of remote antiquity, we shall find that metallurgy was far from being so well under-

stood as in modern times. The use of bronze was very early introduced into the arts; the ornaments of warlike instruments are more easily formed of that metal than of iron; and indeed almost all the fragments of arms discovered at the present day prove to be alloys that differ only in the greater or less proportion of tin added to the copper; and though the discovery of the art of making steel has occasioned the disuse of brass instruments, it is not the less true that this metal and its alloys are still capable of furnishing important resources.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Highland and Agricultural Society of Scotland.

ON the 10th of January this Society held their anniversary general meeting, which was attended uy upwards of one hundred noblemen and gentlemen. Having taken into consideration the business which had come before the committee of directors since the last meeting, the members highly approved of their attention to the objects of the institution, which appeared from a number of premiums adjudged to authors of essays of merit on subjects connected with the improvement of agriculture and the fisheries, by which much useful information had been obtained. The Society likewise approved of the premiums voted for the improvement of waste lands, raising green crops, meliorating the breed of black cattle, curing the diseases incident to sheep, and for exciting emulation among ploughmen. As a considerable increase was found to have

have taken place in the funds of the Society, a larger sum than usual was voted to be laid out in premiums towards the encouragement of useful objects during the present year.

The utility of an investigation and enquiry into the comparative quality of English and Scots barley, and of bigg compared with barley, for the purpose of being made into malt, being suggested, the society referred to the directors to take the necessary measures for obtaining such information.

Sir John Sinclair presented a memorial on the general advantage to the country of opening a speedy communication, by a diligence or mail-coach, from Perth by the Highland Road to Inverness, and of course to the northern counties of Ross, Sutherland, and Caithness, which, upon the motion of that gentleman, was likewise referred to the committee of directors.

The secretary reported that the second volume of the Society's Transactions had been published since the last anniversary, and was received with much approbation, as containing important information, and experiments on various subjects, connected with the objects of the institution.

It was also mentioned by the secretary, that reports had been made by some of the members on the success of the Egyptian barley and Ruta Baga, presented to the Society by Mr. Benjamin Bell, and distributed in very small parcels, for experiments; and particularly that a very distinct and accurate report had been received from Lord Balmuto, by which it appears that the Egyptian barley, if proper attention be paid to the cultivation, is likely to prove a valuable acquisition.

Description

Description of a Mechanical Pulley.

The French Minister of the Interior having requested the opinion of the Class of Mathematical and Physical Sciences of the National Institute, on the various machines of M. Fyot, formerly Professor of Mathematics; Messrs. Bossut and Leroy were appointed to examine the inventions of that mechanic, who has spent the greatest part of his long life in contriving new machines that might be serviceable to society.

Among these machines, that which most attracted the notice of the deputies was his mechanical pulley. This is an ingenious contrivance, and deserves to be described. It is so constructed that a weight may be raised without running any risk of the cord slipping, or the pulley turning round, so that it remains suspended without danger.

The body, properly speaking, of this mechanical pulley is a cylinder, of the diameter that would have been given to the groove, and the same thickness as a common pulley. This cylinder is fixed into an arm, which has two pivots. To each side of this arm is fastened a small piece of wood, of sufficient diameter to form, above the cylinder just mentioned, a narrow passage, the sides of which are of such a height as to contain properly the cord that is intended to run through it. These two pieces project on the side opposite to that on which they touch the cylinder, and are of a suitable thickness. They have grooves, which begin at a certain distance from the centre, and proceed to the circumference; and on their inner surface they are made rough, that they may the better hold the cord. A kind of fork, moveable on pivots, is continually pressed by a spring against the two pieces of wood, so that each of its teeth enters the grooves made in them. If this be clearly understood it is easy to conceive

conceive that when the cord is pulled in the usual way the fork is no obstacle to the motion of the pulley; but the moment it is loosed, the fork, pressing, by the effect of the spring, against the projecting pieces of the wood, by these means hold the cord tight in this artificial passage, and prevents it from slipping, while the pulley itself is stopped by the teeth of the fork that fix themselves into the grooves. There is a lever which serves upon occasion to remove the springs, and prevent their action.

Meteorology.

The following is an account of the depth of rain fallen in Liverpool in the last six months of 1803, and the evaporation of water out of a vessel four inches diameter, placed out of the reach of the solar rays, or influence of fire. Continued from vol. III. page 238.

	Fall of Rain.	Evaporation of Water, &c.
	Inches.	Inches.
Total during the first Six Months . . .	11,73	11,91
July	1,54	3,
August	1,88	2,88
September	1,60	2,55
October	,82	1,55
November	3,25	1,10
December	4,60	1,
Total . . .	25,42	23,69

List

List of Patents for Inventions, &c.

(Continued from Page 160.)

JAMES STURMAN SEARLES, of Little Alic-street, Goodman's-fields, in the parish of St. Mary, Whitechapel, in the county of Middlesex, Gun-maker; for an improvement or improvements to be applied to any kind of fire-arms or defensive instruments.
Dated December 3, 1803.

CHARLES WYATT, of New Bridge-street, in the city of London, Merchant; for a new-invented process of purifying ardent spirits.
Dated December 21, 1803.

ROBERT CROSS, of Quakers Brook within Houghton, in the county of Lancaster, Tanner, and THOMAS SOUTHWORTH, of Houghton, aforesaid, Cotton-manufacturer; for their new-invented mode of heating such pans, vats, cisterns, and other vessels, as are required to be heated by fire, and used for working steam-engines, and in the businesses of calico-printer, dyer, brewer, paper-maker, bleacher, salt-maker, tanner, and other such like trades; by which invention much expense will be saved, not only in the fuel to be used in the heating of such vessels, but also in constructing the vessels themselves.
Dated December 31, 1803.

ERRATA.

In page 81, line 6, *for* 1803 *read* 1793.
126, 4, *for* safflower *read* zaffre.
135, 15, *for* lobes *read* receivers.

[redacted]

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XXII. SECOND SERIES. March 1, 1804.

Specification of the Patent granted to RICHARD TREVITHICK *and* ANDREW VIVIAN, *of the Parish of Camborne, in the County of Cornwall, Engineers and Miners; for Methods for improving the Construction of Steam-Engines, and the Application thereof for driving Carriages, and for other Purposes.* Dated March 24, 1802.

With Plates.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Andrew Vivian do hereby declare that our said invention is described in manner following; that is to say: Our improvements in the construction and application of steam-engines are exhibited in the drawings hereunto annexed and explained, (see Plates IX. X. XI.) namely, Fig. 1 represents the vertical section of a steam-engine, with the said improvements; and Fig. 2 represents another vertical section of the same engine, at right angles to the plane of Fig. 1. The dark-shaded parts represent iron, and the red parts represent brick-work, and the yellow parts are brass, excepting only the wooden supporters of the great frame in Figs. 4 and 5, and the carriage wheels in Figs. 6

and

and 7 *. A, represents the boiler made of a round figure, to bear the expansive action of strong steam. The boiler is fixed in a case D, luted inside with fire clay, the lower part of which constitutes the fire place B, and the upper cavity affords a space round the boiler, in which the flame or heated vapour circulates round till it comes to the chimney E. The case D, and the chimney, are fixed upon a platform F, the case being supported upon four legs; C, represents the cylinder inclosed for the most part in the boiler, having its nozzle, steam-pipe, and bottom, cast all in one piece, in order to resist the strong steam, and with sockets in which the iron uprights of the external frame are firmly fixed. G, represents a cock for conducting the steam, as may be more clearly seen by observing Fig. 3, which is a plan of the top of the cylinder, and the same parts in Fig. 2.—*b*, Figs. 2 and 3, represent the passage from the boiler to the cock G; this passage has a throttle valve, or shut, adjustible by the handle *m*. Fig. 2, so as to wiredraw the steam, and suffer the supply to be quicker or slower. The position of the cock, represented in Fig. 3, is such, that the communication from the boiler through *b*, by a channel in the cock is made good to *d*, which denotes the upper space of the cylinder above the piston, at the same time that the steam pipe *a*, (more fully represented in Fig. 1,) is made to afford a passage from the lower space in the cylinder beneath the piston to the channel C, through which the steam may escape into the outer air, or be directed and applied to heating fluids or other useful purposes. It will be obvious, that if the cock be turned one quarter of a turn in either direction, it will make a communication (Fig. 3.) from the

* The colouring is not introduced in our plates, but the respective materials which they indicate in the original will be obvious to every intelligent engineer.

boiler

boiler passage *b*, to the lower part of the cylinder by or through *a*, at the same time that the passage *r* from the upper part of the cylinder will communicate with C, the passage for conveying off the steam. P Q, is the piston-rod moving between guides, and driving the crank R S, by means of the rod Q R, the axis of which crank carries the fly T, and is the first mover to be applied to drive machinery as at S and W.

Fig 2. The alternations of action are made by the successive pressure of the steam above and below the piston, and these are effected by turning the cock a quarter turn at the end of each stroke, by means of the following apparatus most fully delineated in Fig. 1.

X Y, is a double snail, which in its rotation presses down the small wheel O, and raises the weight N by a motion on the joint M, of the lever O N, from which proceeds downwards an arm M L, and consequently the extremity L is at the same time urged outwards. This action draws the horizontal bar L I, and carries the lever or handle H I, which moves upon the axis of the cock G, through one-fourth of a circle. It must be understood that H I is fore-shortened, (the extremity I being more remote from the observer than the extremity H), and also that there is a click and ratchet wheel in the part H, which gathers up during the time that L is passing outwards, and does not then move the cock G; but that, when the part X, of the snail opposite O, that is to say, when the piston is about the top of its stroke, then the wheel O suddenly falls into the concavity of the snail; and the extremity of L by its return at once pushes I H through the quarter circle, and carries with it the cock G, and turns the steam upon the top of the piston, and also affords a passage for the steam to escape from beneath the piston. Every stroke, whether up or down,

produces this effect by the half turn of the snail, and reverses the steam-ways as before described; or otherwise the cock may be turned by various well-known methods, such as the plug with pins or clamps striking on a lever in the usual way, and the effect will be the same, whether the quarter turns be made back or forward, or by a direct circular motion, as is produced by the machinery here delineated; but the wear of the cock will be more uniform and regular if the turns be all made the same way. In the steam engines constructed and applied according to our said invention, the steam is usually let off or conducted out of the engine; and in this case no vacuum is formed in the engine, but the steam after the operation is or may be usefully applied as before-mentioned; but whenever it is found convenient or necessary to condense the steam by injection-water, we use a new method of condensing by an injection above the bucket of the air-pump, and by this invention we render the condenser or space which is usually constituted or left between the said bucket, and a foot valve, entirely unnecessary; and we perfectly exclude the admission of any elastic fluid from the injection-water into the internal working spaces of the engine. In Fig. 2 is represented a method of heating the water for feeding the boiler by the admission of steam, after its escape through C into the cistern *f*; the steam passes under a false bottom *e*, perforated with small holes, and heats the water therein, a portion of which water is driven at every revolution of the fly by the small pump *k*, through *l z*, into the boiler A. We also, on some occasions, produce a more equable rotary motion in the several parts of the revolution of any axis moved by steam engines, by causing the piston rods of two cylinders to work on the said axis by cranks at one quarter turn asunder; by this means the strongest

strongest part of the action of one crank is made to assist the weakest or most unfavourable part of the action in the other, and it becomes unnecessary to load the work with a fly. Fig. 4 is an upright section, and Fig. 5 is a plan of the engine with rollers, for pressing or crushing sugar canes, moved by a steam engine, improved and applied according to our said new invention; B, is a case in the form of a drum or cylinder, suspended upon two strong trunnions or pivots at O and O, its flat ends standing upright; within this iron case is fixed a boiler A, not much smaller in its dimensions, but so as to leave a vacant space between itself and the case, and within the boiler is fixed a fire-place, having its grate above the ash-hole D, and which the heated vapour and smoke rises at the inner extremity, and passes through two flues E E, Fig. 5, which join above at E *m*, Fig. 4, in the chimney E, which is there loosely applied, and is slung between centres in a ring at F. The working cylinder C, with its piston, steam-pipe, nozzle, and cock, are inserted in the boiler as here delineated. The piston rod drives the fly T T, upon the arbor of which is fixed a small wheel, which drives a great wheel upon the axis of the middle roller; the guides are rendered unnecessary in this application of the steam-engine, because the piston-rod is capable, by an horizontal vibratory motion of the whole engine upon its pivots O, to adapt itself to all the required positions, and while the lower portion of the chimney E *m*, Fig. 4, partakes of this vibratory motion, the upper tube E F, is enabled to follow it by its play upon the two centres or pivots in the ring F. In such cases or constructions as may render it more desireable to fix the boiler with its chimney and other apparatus, and to place the cylinder out of the boiler, the cylinder itself may be suspended for the same purpose upon trunnions

nions or pivots in the same manner, one or both of which trunnions or pivots may be perforated, so as to admit the introduction and escape of the steam or its condensation as before-mentioned. And in such cases where it may be found necessary or expedient, to allow of no vibratory motion of the boiler or cylinder, the same may be fixed, and the method of guides be made use of as in Figs. 1 or 2. The manner in which the cock is turned is not represented in these two drawings, but every competent workman will, without difficulty, understand that this effect may be produced by the same means as in Fig. 1; or otherwise the stroke of pins duly placed in the circumference of the fly, and made to act upon a cross fixed on the axis of the cock, or otherwise by the method used in the carriage, Fig. 6, and hereinafter described. The steam which escapes in this engine is made to circulate in the case round the boiler, where it prevents the external atmosphere from affecting the temperature of the included water, and affords by its partial condensation a supply for the boiler itself, and is or may be afterwards directed to useful purposes as aforesaid. Fig. 6 is a verticle section; and Fig. 7 the plan of the application of the improved steam-engine, to give motion to wheel carriages of every description; B, represents the case, having therein the boiler with its fire-place and cylinder, as have been already described in Fig. 4. The piston rod P Q, Fig. 7, is divided or forked, so as to leave room for the motion of the extremity of the crank R; the said rod drives a cross piece at Q, backward and forward between guides, and this cross piece by means of the bar Q R, gives motion to the crank with its fly F, and to two wheels T T, upon the crank axis which lock into two correspondent wheels U, upon the naves of the large wheels of the carriage itself. The wheels T, are fixed

fixed upon round sockets, and receive their motion from a striking box or bar S X, which acts upon a pin in each wheel; S Y are two handles, by means of which either of the striking boxes S X can be thrown out of gear, and the correspondent wheel W by that means disconnected with the first mover for the purpose of turning short, or admitting a backward motion of that wheel when required; but either of the wheels W, in case of turning, can be allowed considerably to overrun the other without throwing S X out of gear, because the pin can go very nearly round in the forward motion before it will meet with any obstruction. The wheels U, are most commonly fixed upon the naves of the carriage-wheels W, by which means a revolution of the axis itself becomes unnecessary, and the outer ends of the said axis may consequently be set to any obliquity, and the other part fixed or bended as the objects of taste or utility may demand. The fore wheels are applied to direct the carriage by means of a lever H, and there is a chink lever which can be applied to the fly, in order to moderate the velocity of progression while going down hill. In the vertical section, *r u* denotes a springing lever, having a tendency to fly forward. Two levers of this kind are duly and similarly placed near the middle of the carriage, and each of them alternately thrown back by a short bearing lever S *t* upon the crank axis, which sends it home into the catch *u*, and afterwards disengages it when the bearing lever comes to press upon V, in which case the springing lever flies back. A cross bar, or double handle *o p*, is fixed upon the upright axis of the cock, from each end of which said cross bar proceeds a rod *p q*, which is attached to a stud *q*, that forms part of the spring lever *r u*. This stud has a certain length of play, by means of a long hole or groove in the bar, so that when

Fig. 2.

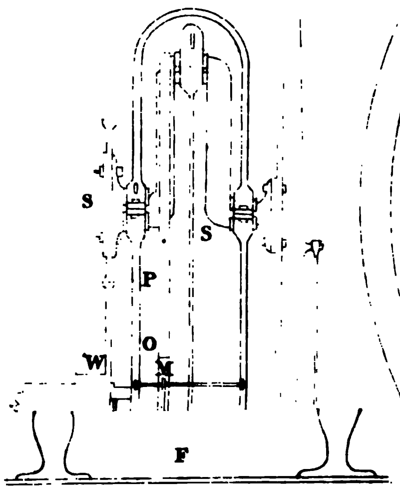
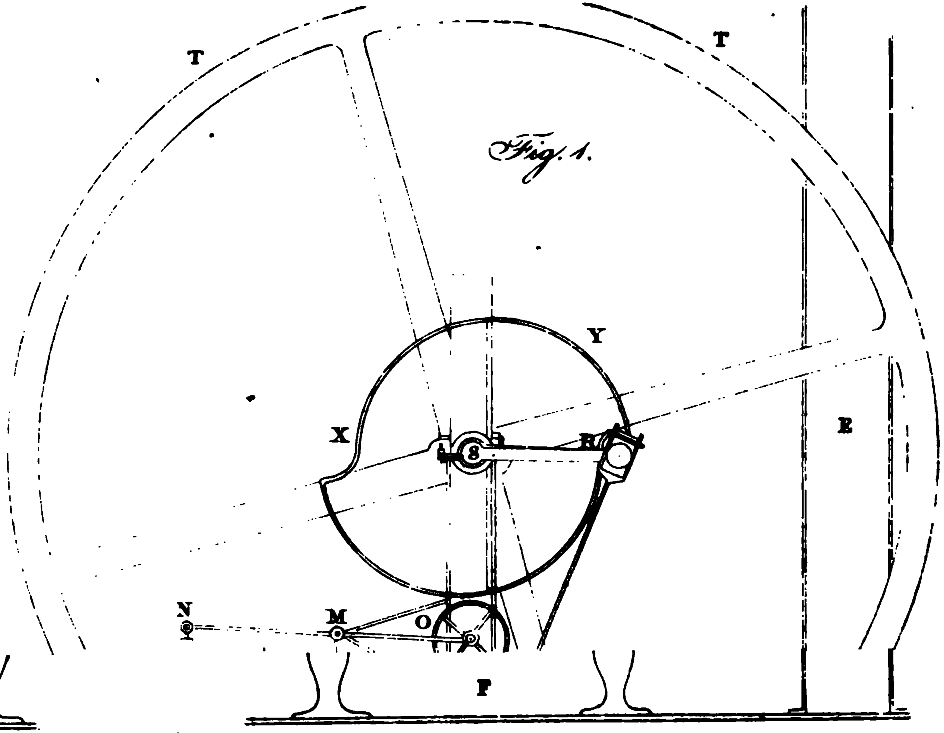


Fig. 1.



uses. And lastly, we do occasionally use bellows to excite the fire, and the said bellows are worked by the piston-rod or crank, and may be fixed in any situation or part of the several engines herein described, as may be found most convenient.

In witness whereof, &c.

Specification of the Patent granted to JOSEPH EVERETT, *of Salisbury, in the County of Wilts, Clothier; for a certain Article manufactured of different Materials, and wove in a peculiar Manner, so as to give it an Appearance of Velvet, which he denominates "Salisbury Angola Moleskin."* Dated June 30, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Joseph Everett do hereby describe and ascertain the nature of my said invention as follows; that is to say: I manufacture the Salisbury Angola Moleskin on two chains or warps, the upper chain is invariably woollen yarn, but the under chain is of cotton, linen, silk, mohair, or worsted. The above two chains are upon separate beams, the number of threads in the upper chain is two-fifths of the whole number in both chains; wires being introduced when the upper chain is clear upon the surface of the ground, and kept confined by three threads of weft till cut out by an instrument, the face or pile is formed; the weft is of cotton, linen, silk, mohair, worsted, or woollen yarn.

In witness whereof, &c.

Specification of the Patent granted to Joseph Hately, *of Cradely, in the County of Worcester, Assayer of Metals; for some reducing Fluxes for the Purification of Mineral and Metallic Bodies, with combustive and phlogistive Substances from their primitive Ores, to purify Metals in Conjunction with or without compressed Air.*

Dated August 31, 1802.

To all to whom these presents shall come, &c. I Joseph Hately do hereby describe that the nature of my said invention, and the manner in which the same is to be effected and performed, is particularly described and ascertained in the following specification herein-after mentioned; that is to say: The purification of mineral and metallic bodies extracted from their primitive ores, either in a crude or metallic state, is effected by the addition and application of the fluxes hereafter expressed, or any of them separately by themselves, or any mixture of them together, with or without absorbent substances of lime, gypsum, chalk, and whiting mixed therewith, consisting of the residue adhering to salt-pans and boilers, in which the sea-water brine from brine pits and salt rock are boiled, which is commonly called pancrach, common salt, rock salt, sal ammoniac, alum, glasgail called sandiver, nitre, tartar, vegetable, mineral, and animal salts; salts of any denomination in a humid or dry state.

In some cases I use salt water, brine from brine pits, or water strongly impregnated with any of the recited salts, in manner hereinafter described: viz. to refine copper, lead, tin, zinc, bismuth, and antimony, the ores are first cleaned and pulverized for melting in the usual manner, either in the great or small way.

The fluxes may be used either in a crude or prepared state; the latter I prefer, which is done by melting the salts in

in melting pots or furnaces, and mixing them, or any of them, or all of them in equal parts, with two parts of the recited absorbent substances separately or together in a calcined state. Of that composition, I use two pounds weight to every hundred weight of crude ore, before expressed, and four pounds weight of the unprepared to the same quantity of ore aforesaid, more or less thereof, as the ores or metals may require for rendering them ultimately pure.

To refine iron ores, or iron mine, and pig metal made therefrom, the ores or mine thereof are to be pulverized and calcined in ovens or kilns with vegetable fuel, and the carbonated pit-coal, commonly called coaks, are washed in water, strongly impregnated with common salt or any of the recited salts before expressed, or sea water or brine from brine pits. The pig metal made therefrom, or the pig iron extracted by the usual process or common principles, I refine and purify with combustive and phlogistive substances, mineral or vegetable, prepared or unprepared as aforesaid, with addition of prepared or unprepared fluxes aforesaid, in proportion of three pounds thereof to one hundred weight of pig metal, more or less, as the foulness of the metal and fuel may require, when melting in a finery or in arunout fire, or in any other fire or furnace applicable thereto, with or without compressed air. The metal so refined as before expressed, or pig metal unrefined, is purified by the addition of the aforesaid fluxes in the following proportions: viz. to the refined metal as aforesaid, while it is in the puddling furnace or finery in a fluid state, I add thereto half a pound of the prepared flux, and to the unprepared pig metal in the puddling furnace is added four pounds of the said flux, more or less, if required to dispel the heterogeneous matter; but the former process

I prefer when the iron is intended for the finest and best purposes, and for making steel, as the fluxes have the best effect when the metal is in contact with the fuel that possesses the least quantity of sulphur and other pernicious substances, that oppose malleability, ductility, and stability of metals.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM BOOND, *of Manchester, in the County of Lancaster, Cotton Manufacturer; for a new Manufacture of mixed and coloured Cotton Velvets, Velveteens, Velverets, Thicksets, Cords, and other Cotton Pile Goods, commonly called Fustians.*

Dated April 5, 1803.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Boond do hereby particularly describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say: I take the cotton after it is picked and batted, or cleared of its seeds and other dirt which it may at any time collect by being exposed, and dye it or get it dyed in the usual way cotton is dyed, either fast or loose colours, to any shade or colour which fancy may dictate. After it is dyed I again batt it, open it, and pick out all the hard knots or lumps that would anywise injure the cards of the carding machine; and proceed to card, stretch, and rove it separately in the usual way cotton is carded, stretched, and roved; by this means I obtain dyed and undyed rovings. I now proceed to spin them together thus: I place a dyed roving and an undyed or coloured

coloured roving in the frame or creel of a spinning machine, made for that purpose, and spin two or more rovings together into one thread, or one spindle, or bobbin; by this means I make a mixture or mottled thread or weft, which weft I weave into the aforesaid goods; that is to say: cotton velvets, tabby or Genoa velveteens, tabby or Genoa velverets, tabby or Genoa thicksets, tabby or Genoa cords of every description whatever; or any other description of cotton or pile goods, commonly called fustians. After the goods are woven, I proceed to raise the pile or finish them, so as to shew the mixture or mottle thus: I cut the face or tuft of the pieces longitudinally in a frame with knives, as fustians in the grey are usually cut; after they are cut, I immerge them in lukewarm water, in which water I sometimes dissolve a little allum, or anything else that will serve to soften or brighten the colour, and dry them in the open air or in a stove. When the pieces are well dried, I rub them across or longitudinally with brushes, and a stone to raise the pile and make it knit together; this operation I repeat till such time as the pieces are well milled, and the pile well knit together; some pieces when they have undergone this last operation will be sufficiently finished and ready for sale; and on others there will be on the top of the pile a kind of down, or ouse, or loose strands of cotton, that will not knit in with the pile; these (if made of loose colours) I cut off with a large pair of shears (after the manner woollen cloth is sheared), to clear the pile and make the mixture more perceptible; this operation of shearing is repeated till the face or pile is clear to the satisfaction of the manufacturer, and the piece is then ready for sale; the goods that are made of such colours as will stand bleeching, I sometimes draw over a red-hot iron, to clear the pile, and afterwards bleach the brown

brown off again, and sometimes clear them by shearing as above. There are several ways of making this mixed or mottled thread or weft; such as: first, by mixing the dyed and undyed, or coloured cotton together before carding; secondly, by stretching dyed and undyed cardings together on the stretching frame; thirdly, by roving dyed and undyed stretchings together on the roving frame; fourthly, by dying the weft in the bank, and doubling and twisting the dyed and undyed threads together; and fifthly, by clouding and stamping the weft before it is woven: all these ways I use, but give the preference to spinning the rovings together to make an even mixture as before. The part or parts I claim as my invention, is the weaving or manufacturing mixed or mottled cotton, weft, or yarn, prepared by the aforesaid means into such pile goods as before enumerated, and for finishing the same mixed or mottled goods after they are woven, so as to make a mixed or mottled pile in the aforesaid goods, similar to mixed or mottled woollen cloth or kerseymere by the aforesaid means, which have never been practised before on these kinds of cotton pile goods.

In witness whereof, &c.

A chemical Analysis of some Calamines. By JAMES SMITHSON, *Esq. F. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

NOTWITHSTANDING the experiments of Bergman and others, on those ores of zinc which are called calamine, much uncertainty still subsisted on the subject of them. Their constitution was far from decided, nor was it

it ever determined whether all calamines were of the same species, or whether there were several kinds of them.

The Abbé Hauy, so justly celebrated for his great knowledge in crystallography and mineralogy, has adhered, in his late work *, to the opinions he had before advanced †, that calamines were all of one species, and contained no carbonic acid, being a simple calx of zinc, attributing the effervescence which he found some of them to produce with acids to an accidental admixture of carbonate of lime.

The following experiments were made to obtain a more certain knowledge of these ores; and their results will show the necessity there was for their farther investigation, and how wide from the truth have been the opinions adopted concerning them.

Calamine from Bleyberg.

a. The specimen which furnished the subject of this article was said, by the German of whom it was purchased, to have come from the mines of Bleyberg in Carinthia.

It was in the form of a sheet stalactite, spread over small fragments of limestone. Its texture was not however at all crystalline, but of the dull earthy appearance of chalk, though, on comparison, of a finer grain and closer texture.

It was quite white, perfectly opaque, and adhered to the tongue; 68,0 grs. of it, in small bits, immersed in distilled water, absorbed 19.8 grs. of it, = 0,29.

It admitted of being scraped by the nail, though with some difficulty: scraped with a knife, it afforded no light.

* Traité de Mineralogie, tome IV. † Journal des Mines.

68.1

68.1 grs. of it, broken into small pieces, expelled 19.0 grs. of distilled water from a stopple bottle. Hence its density = 3.584. In another trial, 18.96 grs. at a heat of 65° Fahrenheit, displaced 5.27 grs. of distilled water; hence the density = 3.598. The bits, in both cases, were entirely penetrated with water.

b. Subjected to the action of the blowpipe on the coal, it became yellow the moment it was heated, but recovered its pristine whiteness on being let cool. This quality, of temporarily changing their colour by heat, is common to most, if not all, metallic oxides; the white growing yellow, the yellow red, the red black.

Urged with the blue flame, it became extremely friable; spread yellow flowers on the coal; and, on continuing the fire no very long time, entirely exhaled. If the flame was directed against the flowers, which had settled on the coal, they shone with a vivid light. A bit fixed to the end of a slip of glass, wasted nearly as quickly as on the coal.

It dissolved in borax and microcosmic salt, with a slight effervescence, and yielded clear colourless glasses; but which became opaque on cooling, if over saturated. Carbonate of soda had not any action on it.

c. 68.0 grs. of this calamine dissolved in dilute vitriolic acid with a brisk effervescence, and emitted 9.2 grs. of carbonic acid. The solution was white and turbid, and on standing deposited a white powder, which, collected on a small filter of gauze paper, and well edulcorated and let dry, weighed only 0.86 gr. This sediment, tried at the blowpipe, melted first into an opaque white matter, and then partially reduced into lead. It was therefore, probably, a mixture of vitriol of lead and vitriol of lime.

The

The filtered solution, gently exhaled to dryness, and kept over a spirit-lamp till the water of crystallization of the salt and all superfluous vitriolic acid were driven off, afforded 96.7 grs. of perfectly dry, or *arid**, white salt. On re-solution in water, and crystallization, this saline matter proved to be wholly vitriol of zinc, excepting an inappretiable quantity of vitriol of lime in capillary crystals, due, without doubt, to a slight and accidental admixture of some portion of the calcareous fragments on which this calamine had been deposited. Pure martial pruissate of tartar threw down a white precipitate from the solution of this salt.

In another experiment, 20.0 grs. of this calamine afforded 28.7 grs. of arid vitriol of zinc.

d. 10 grs. of this calamine were dissolved in pure marine acid, with heat. On cooling, small capillary crystals of muriate of lead formed in the solution. This solution was precipitated by carbonate of soda, and the filtered liquor let exhale slowly in the air; but it furnished only crystals of muriate of soda.

e. 10 grs. dissolved in acetous acid without leaving any residuum. By gentle evaporation, 20.3 grs. = 2.03, of acetite of zinc, in the usual hexagonal plates, were obtained. These crystals were permanent in the air, and no other kind of salt could be perceived amongst them.

Neither solution of vitriolated tartar, nor vitriolic acid, occasioned the slightest turbidness in the solution of these crystals, either immediately or on standing; a proof that

* *Dry*, as opposed to wet or damp, which are only degrees of each other, merely implies free from mechanically admixed water. *Arid*, may be appropriated to express the state of being devoid of combined water.

the quantity of lime and lead in this solution, if any, was excessively minute.

f. A bit of this calamine, weighing 20.6 grs. being made red-hot in a covered tobacco-pipe, became very brittle, dividing on the slightest touch into prisms, like those of starch, and lost 5.9 grs. of its weight = 0.286. After this, it dissolved slowly and difficultly in vitriolic acid, without any effervescence.

According to these experiments, this calamine consists of,

Calx of zinc - -	0.714
Carbonic acid - -	0.135
Water - - -	0.151
	1.000

The carbonates of lime and lead in it are mere accidental admixtures, and in too small quantity to deserve notice.

Calamine from Somersetshire.

a. This calamine came from Mendip Hills in Somersetshire.

It had a mammillated form; was of a dense crystalline texture; semitransparent at its edges, and in its small fragments; and upon the whole very similar, in its general appearance, to calcedony.

It was tinged, exteriorly, brown; but its interior colour was a greenish yellow.

It had considerable hardness; it admitted, however, of being scraped by a knife to a white powder.

56.8 grs. of it displaced 13.1 grs. of water, at a temperature of 65° Fahrenheit. Hence its density = 4.336.

b. Exposed to the blowpipe, it became opaque, more yellow, and friable; spread flowers on the coal, and con-

consequently volatilized, but not with the rapidity of the foregoing kind from Bleyberg.

It dissolved in borax and microcosmic salt, with effervescence, yielding colourless glasses. Carbonate of soda had no action on it.

c. It dissolved in vitriolic acid with a brisk effervesence; and 67.9 grs. of it emitted 24.5 grs. = 0.360, of carbonic acid. This solution was colourless; and no residuum was left. By evaporation, it afforded only vitriol of zinc, in pure limpid crystals.

d. 23.0 grs. in small bits, made red-hot in a covered tobacco-pipe, lost 8.1 grs. = 0.352. It then dissolved slowly and difficultly in vitriolic acid, without any emission of carbonic acid; and, on gently exhaling the solution, and heating the salt obtained, till the expulsion of all superabundant vitriolic acid and all water, 29.8 grs. of arid vitriol of zinc were obtained. This dry salt was wholly soluble again in water; and solution of pure martial prussiate of soda occasioned a white precipitate in it.

This calamine hence consissts of,

Carbonic acid - -	0.352
Calx of zinc - - -	0.648
	1.000.

Calamine from Derbyshire.

a. This calamine consisted of a number of small crystals, about the size of tobacco-seeds, of a pale yellow colour, which appeared, from the shape of the mass of them, to have been deposited on the surface of crystals of carbonate of lime, of the form of Fig. 28. Plate IV. of the *Cristallographie* of Romé de L'Isle.

The smallness of these calamine crystals, and a want of sharpness, rendered it impossible to determine their

 form

form with certainty; they were evidently, however, rhomboids, whose faces were very nearly, if not quite, rectangular, and which were incomplete along their six intermediate edges, apparently like Fig. 78. Plate IV. of Romé de L'Isle.

22.1 grs. of these crystals, at a heat of 57° Fahrenheit, displaced 5.1 grs. of water, which gives their density = 4.333.

Heat did not excite any electricity in these crystals.

b. Before the blowpipe, they grow more yellow and opaque, and spread flowers on the coal. They dissolved wholly in borax and microcosmic salt, with effervescence.

c. 22.0 grs. during their solution in vitriolic acid, effervesced, and lost 7.8 grs. of carbonic acid = 0.354. This solution was colourless, and afforded 26.8 grs. of arid vitriol of zinc, which, redissolved in water, shot wholly into clear colourless prisms of this salt.

d. 9.2 grs. of these crystals, ignited in a covered tobacco-pipe, lost 3.2 grs. = 0.3478; hence, these crystals consist of,

Carbonic acid - -	0.348
Calx of zinc - - -	0.652
	1.000.

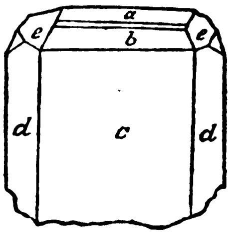
Electrical Calamine.

The Abbé Hauy has considered this kind as differing from the other calamines only in the circumstance of being in distinct crystals; but it has already appeared, in the instance of the Derbyshire calamine, that all crystals of calamine are not electric by heat, and hence, that it is not merely to being in this state that this species owes the above quality. And the following experiments, on some crystals of electric calamine from Regbania in Hungary,

Hungary, can leave no doubt of its being a combination of calx of zinc with quartz; since the quantity of quartz obtained, and the perfect regularity and transparency of these crystals, make it impossible to suppose it a foreign admixture in them.

a. 23.45 grs. of these Regbania crystals, displaced 6.8 grs. of distilled water, from a stopple-bottle, at the temperature of 64° Fahrenheit; their specific gravity is therefore = 3.434.

The form of these crystals is represented in the annexed Figure.



a c = 90°.
a e = 150°.
b c = 115°.
c d = 130°.

They were not scratched by a pin; a knife marked them.

b. One of these crystals, exposed to the flame of the blowpipe, decrepitated and became opaque, and shone with a green light, but seemed totally infusible.

Borax and microcosmic salt dissolved these crystals, without any effervescence, producing clear colourless glasses. Carbonate of soda had little if any action on them.

c. Ac-

c. According to Mr. Pelletier's experiments * on the calamine of Fribourg in Brisgaw, which is undoubtedly of this species, its composition is,

Quartz - - -	0.50
Calx of zinc - - -	0.38
Water - - - -	0.12
	1.00

The experiments on the Regbania crystals have had different results; but, though made on much smaller quantities, they will perhaps not be found, on repetition, less in conformity with nature.

23.45 grs. heated red-hot in a covered crucible, decrepitated a little, and became opaque, and lost 1.05 gr. but did not fall to powder or grow friable. It was found, that this matter was not in the least deprived of its electrical quality by being ignited; and hence, while hot, the fragments of these decrepitated crystals clung together, and to the crucible.

d. 22.2 grs. of these decrepitated crystals, = 23.24 grs. of the original crystals, in a state of impalpable powder, being digested over a spirit-lamp with diluted vitriolic acid, showed no effervescence; and, after some time, the mixture became a jelly. Exhaled to dryness, and ignited slightly, to expel the superfluous vitriolic acid, the mass weighed 37.5 grs.

On extraction of the saline part by distilled water, a fine powder remained, which, after ignition, weighed 6.8 grs. and was quartz.

The saline solution afforded, on crystallization, only vitriol of zinc.

* Journal de Physique, tome XX. p. 424.

These

These crystals therefore consist of,

Quartz - - -	0.250
Calx of zinc - -	0.683
Water - - -	0.044
	0.977
Loss - - -	0.023
	1.000.

The water is most probably not an essential element of this calamine, or in it in the state of, what is improperly called, water of crystallization, but rather exists in the crystals in fluid drops interposed between their plates, as it often is in crystals of nitre, of quartz, &c. Its small quantity, and the crystals not falling to powder on its expulsion, but retaining almost perfectly their original solidity, and spathose appearance in the places of fracture, and, above all, preserving their electrical quality wholly unimpaired, which would hardly be the case after the loss of a real element of their constitution, seem to warrant this opinion.

If the water is only accidental in this calamine, its composition, from the above experiments, will be,

Quartz - - -	0.261
Calx of zinc - - -	0.739
	1.000.

I have found this species of calamine amongst the productions of Derbyshire, in small brown crystals, deposited, together with the foregoing small crystals of carbonate of zinc, on crystals of carbonate of lime. Their form seems, as far as their minuteness and compression together would allow of judging, nearly or quite the same as that of those from Regbania; and the least atom of

of them immediately evinces its nature, on being heated, by the strong electricity it acquires. On their solution in acids, they leave quartz.

OBSERVATIONS.

Chemistry is yet so new a science, what we know of it bears so small a proportion to what we are ignorant of, our knowledge in every department of it is so incomplete, so broken, consisting so entirely of isolated points thinly scattered like lucid specks on a vast field of darkness, that no researches can be undertaken without producing some facts, leading to some consequences, which extend beyond the boundaries of their immediate object.

1. The foregoing experiments throw light on the proportions in which its elements exist in vitriol of zinc. 23.0 grs. of the Mendip Hill calamine, produced 29.8 grs. of arid vitriol of zinc. These 23.0 grs. of calamine contained 14.9 grs. of calx of zinc; hence, this metallic salt, in an arid state, consists of *exactly equal* parts of calx of zinc and vitriolic acid.

This inference is corroborated by the results of the other experiments: 68.0 grs. of the Bleyberg calamine, containing 48.6 grs. of calx of zinc, yielded 96.7 grs. of arid vitriol of zinc; and, in another trial, 20.0 grs. of this ore, containing 14.2 grs. of calx of zinc, produced 28.7 grs. of arid vitriol of zinc. The mean of these two cases, is 62.7 grs. of arid vitriol of zinc, from 31.4 grs. of calx of zinc.

In the experiment with the crystals of carbonate of zinc from Derbyshire, 14.35 grs. of calx of zinc furnished indeed only 26.8 grs. of arid vitriol of zinc; a deficiency of about $\frac{6}{100}$, occasioned probably by some small inaccuracy of manipulation.

2. When

2. When the simplicity found in all those parts of nature which are sufficiently known to discover it is considered, it appears improbable that the proximate constituent parts of bodies should be united in them, in the very remote relations to each other in which analyses generally indicate them; and an attention to the subject has led me to the opinion that such is in fact not the case, but that, on the contrary, they are universally, as appears here with respect to arid vitriol of zinc, fractions of the compound of very low denominators. Possibly in few cases exceeding five.

The success which has appeared to attend some attempts to apply this theory, and, amongst others, to the compositions of some of the substances above analysed, and especially to the calamine from Bleyberg, induces me to venture to dwell here a little on this subject, and state the composition of this calamine which results from the system, as, besides contributing perhaps to throw some light on the true nature of this ore, it may be the means likewise of presenting the theory under circumstances of agreement with experiment, which, from the surprising degree of nearness, and the trying complexity of the case, may seem to entitle it to some attention.

From this calamine, containing, according to the results of the experiments on the Mendip Hill kind, too small a quantity of carbonic acid to saturate the whole of the calx of zinc in it, and from its containing much too large a portion of water to be in it in the state of mere moisture or dampness, it seems to consist of two matters; carbonate of zinc, and a peculiar compound of zinc and water, which may be named *hydrate of zinc*.

By the results of the analysis of the Mendip Hill calamine, corrected by the theory, carbonate of zinc appears to consist of,

 Car-

Carbonic acid - - $\frac{1}{3}$
Calx of zinc - - - $\frac{2}{3}$

Deducting from the calx of zinc in the Bleyberg calamine, that portion which corresponds, on these principles, to its yield of carbonic acid, the remaining quantity of calx of zinc and water is in such proportions as to lead, from the theory, to consider hydrate of zinc as composed of

Calx of zinc - - $\frac{3}{4}$
Water, or rather ice - - $\frac{1}{4}$.

And, from these results, corrected by the theory, I consider Bleyberg calamine as consisting of,

Carbonate of zinc - - $\frac{2}{5}$
Hydrate of zinc - - $\frac{3}{5}$

The test of this hypothesis is in the quantities of the remote elements which analysis would obtain from a calamine thus composed.

The following table will show how very insignificantly the calamine, compounded by the theory, would differ in this respect from the calamine of nature.

1000 parts of the compound salt of carbonate and hydrate of zinc consist of,

Carbonate of zinc 400 =	Carbonic acid	$= \frac{400}{3} =$	- -	133⅓
	Calx of zinc	$= \frac{400 \times 2}{3} = 266\frac{2}{3}$	} =	716⅔
Hydrate of zinc = 600	Calx of zinc	$= \frac{600 \times 3}{4} = 450$		
	Ice - -	$= \frac{600}{4} =$	- -	150
				1000.

Great

Great as is the agreement between the quantities of the last column and those obtained by the analysis of the Bleyberg calamine (page 266), it would be yet more perfect, probably, had there been, in this instance, no sources of fallacy but those attached to chemical operations, such as errors of weighing, waste, &c. but the differences which exist are owing, in some measure at least, to the admixture of carbonate of lime and carbonate of lead, in the calamine analysed, and also to some portion of water, which is undoubtedly contained, in the state of moisture, in so porous and bibulous a body.

It has also appeared, in the experiments on the Mendip Hill calamine, that acids indicate a greater quantity of carbonic acid than fire does, by $\frac{22}{1000}$. If we make this deduction for dissolved water, it reduces the quantity of carbonic acid in the Bleyberg calamine to 0.1321.

If we assume this quantity of carbonic acid as the datum to calculate, on this system, the composition of the calamine from Bleyberg, we shall obtain the following results:

Compound salt, of carbonate of zinc and hydrate of zinc - - -	990.3
Water, in the state of moisture - -	2.5
Carbonate of zinc and carbonate of lead -	7.2
	1000.0

It may be thought some coroboration of the system here offered, that, if we admit the proportions which it indicates, the remote elements of this ore, while they are regular parts of their immediate products, by whose subsequent union this ore is engendered, are also regular fractions of the ore itself: thus,

The carbonic acid - $= \frac{8}{60}$
The water - - $= \frac{9}{60}$
The calx of zinc - - $= \frac{43}{60}$

 Heredy

Hereby displaying that sort of regularity, in every point of view of the object, which so wonderfully characterises the works of nature, when beheld in their true light.

If this calamine does consist of carbonate of zinc and hydrate of zinc, in the regular proportions above supposed, little doubt can exist of its being a true chemical combination of these two matters, and not merely a mechanical mixture of them in a pulverulent state; and, if so, we may indulge the hope of some day meeting with this ore in regular crystals.

If the theory here advanced has any foundation in truth, the discovery will introduce a degree of rigorous accuracy and certainty into chemistry, of which this science was thought to be ever incapable, by enabling the chemist, like the geometrician, to rectify by calculation the unavoidable errors of his manual operations, and by authorising him to discriminate from the essential elements of a compound those products of its analysis whose quantity cannot be reduced to any admissible proportion.

A certain knowledge of the exact proportions of the constituent principles of bodies, may likewise open to our view harmonious analogies between the constitutions of related objects, general laws, &c. which at present totally escape us. In short, if it is founded in truth, its enabling the application of mathematics to chemistry cannot but be productive of material results *.

3. By the application of the foregoing theory to the experiments on the electrical calamine, its elements will appear to be,

* It may be proper to say, that the experiments have been stated *precisely* as they turned out, and have not been in the *least degree* bent to the system.

Qurrtz

Quartz	- - -	$\frac{1}{4}$
Calx of zinc	- - - -	$\frac{3}{4}$

A small quantity of the calamine having escaped the action of the vitriolic acid, and remained undecomposed, will account for the slight excess in the weight of the quartz.

4. The exhalation of these calamines at the blowpipe, and the flowers which they diffuse round them on the coal, are probably not to be attributed to a direct volatilization of them. It is more probable that they are the consequences of the disoxidation of the zinc calx, by the coal and the inflammable matter of the flame, its sublimation in a metallic state, and instantaneous recalcination. And this alternate reduction and combustion may explain the peculiar phosphoric appearance exhibited by calces of zinc at the blowpipe.

The apparent sublimation of the common flowers of zinc at the instant of their production, though totally unsublimable afterwards, is certainly likewise but a deceptious appearance. The reguline zinc, vaporized by the heat, rises from the crucible as a metallic gas, and is, while in this state, converted to a calx. The flame which attends the process is a proof of it; for flame is a mass of vapour, ignited by the production of fire within itself. The fibrous form of the flowers of zinc is owing to a crystallization of the calx while in *mechanical suspension* in the air, like that which takes place with camphor, when, after having been some time inflamed, it is blown out.

A moment's reflection must evince, how injudicious is the common opinion, of crystallization requiring a state of solution in the matter; since it must be evident, that while solution subsists, as long as a quantity of fluid admitting of it is present, no crystallization can take place. The

The only requisite for this operation is a freedom of motion in the masses which tend to unite, which allows them to yield to the impulse which propels them together, and to obey that sort of polarity which occasions them to present to each other the parts adapted to mutual union. No state so completely affords these conditions as that of mechanical suspension in a fluid whose density is so great, relatively to their size, as to oppose such resistance to their descent in it as to occasion their mutual attraction to become a power superior to their force of gravitation. It is in these circumstances that the atoms of matters find themselves, when, on the separation from them of the portion of fluid by which they were dissolved, they are abandoned in a disengaged state in the bosom of a solution; and hence it is in saturated solutions sustaining evaporation, or equivalent cooling, and free from any perturbing motion, that regular crystallization is usually effected.

But those who are familiar with chemical operations, know the sort of agglutination which happens between the particles of subsided very fine precipitates; occasioning them, on a second diffusion through the fluid, to settle again much more quickly than before, and which is certainly a crystallization, but under circumstances very unfavourable to its perfect performance.

5. No calamine has yet occurred to me which was a real, uncombined, calx of zinc. If such, as a native product, should ever be met with in any of the still-unexplored parts of the earth, or exist amongst the unscrutinized possessions of any cabinet, it will easily be known, by producing a quantity of arid vitriol of zinc exactly double its own weight; while the hydrate of zinc, should it be found single, or uncombined with the carbonate, will yield, it is evident, 1.5 its weight of this arid salt.

On

On Meteorology, as applicable to Husbandry.

By the Rev. Mr. Holmes.

From Hunter's Georgical Essays.

It is obvious from the effects of the weight and temperature of the air, upon the barometer and thermometer, that the same causes must operate at the same time upon the animal and vegetable kingdoms. If, therefore, the science of meteorology can be rendered subservient to the purposes of the husbandman, so as to enable him to prognosticate the changes of the weather, and the nature of these changes, it appears to me, that the philosopher should direct the farmer's attention to such phænomena in the animal and vegetable kingdoms as may be found to predict such changes. For it is evident, that whatever the most unexceptionable theory, or even demonstration, might effect — in the abstruse, scientific manner of Mr. Kirwan, in his late ingenious essay on the Temperature of different Latitudes, or the truly sagacious and indefatigable Mr. De Luc, in his repeated inquiries into the Modifications of the Atmosphere — it could not be accommodated to the comprehension of a common farmer, except in the way of popular corollaries or inferences. Undoubtedly most of the physical phænomena of meteorology, properly so called, depend upon the incessant decomposition and recomposition of the expansible fluids contained in the atmosphere; yet if the philosopher, capable of accounting for these phænomena, cannot reduce his deductions from them into such language as is intelligible to a common farmer, their utility must consequently be limited to those who perhaps have least occasion to apply them to the exigencies of common life. If such be

be the case, it must be the ardent wish of every friend to the real interests of agriculture—an art universally acknowledged of the last importance to man—that philosophers, capable of executing the task with propriety, would condescend to direct the farmer's attention to such obvious phænomena as might enable him to prognosticate the changes of the weather, which more immediately influence his most important operations. That such phænomena as would answer this desirable purpose are exhibited in the animal and vegetable kingdom, I flatter myself might be easily discovered by a judicious and attentive observer. And though the information derived from these sources might not be so extensive, or afford so much time for application, as that deduced from the other, (supposing abilities for such deduction,) the easiness of its application would more than compensate for this deficiency. For these reasons, I am fully persuaded, that the result of accurate observations, made upon the animal and vegetable kingdoms, and occasionally published, till a mass of well-authenticated information were collected, sufficient to constitute a popular directory, to ascertain the changes of the weather, would be an important acquisition not only to agriculture, properly so called, but to all the most interesting operations of the farmer. From this investigation, I would by no means exclude the use of the barometer, thermometer, hygrometer, or any other instruments calculated to show the changes in the state of the atmosphere; as I have sanguine hopes that the appearances indicated by them may be reduced to much greater accuracy and precision, by comparing them with the phænomena of nature, in the manner I am now recommending to the attentive observer, than can be collected from them at present. As to myself, I can truly declare, that with the strictest attention, and some little

little meteorological knowledge, I have for many years examined and registered the indications of these instruments, without being able to make the least useful deduction from any of them, as a farmer, or derive any scientific information from them, excepting the thermometer, as a philosopher. The common farmer, therefore, absolutely wants some easy certain rules to ascertain the changes of the weather, and the nature of these changes; for information in the latter case it is in vain to consult any mechanical instruments. If then the animal, vegetable, and mineral kingdoms, particularly the two first, exhibit such appearances as indicate a change of weather, and by accurate and repeated observations we be enabled to prognosticate the nature of that change, we shall have a sure criterion of the weather from the vernal to the autumnal equinox, a season of prime importance to the farmer. We know from experience, particularly such of us as are of a delicate, irritable constitution, that changes of the weather affect us very sensibly; and analogy leaves us not the least reason to doubt but that every beast, bird, and insect are affected by the same causes, and, if attentively observed, would afford useful information with respect to these changes. Many vegetables too exhibit very curious and significant indications of atmospherical influences, and repeated observations made upon these, corrected and assisted by collateral observations made upon the other sources of meteorological information, would in time afford such certain and infallible rules for prognosticating the weather, as would not be far short of absolute demonstration. I hope no person will object to the unwarrantable extension I have given to the meaning of the word meteorology; I am conscious that what I am recommending to the attention of the philosophical observers of nature, is not properly the

 science

science of meteors, but of their effects; but if it be a more compendious, more popular, and consequently a more useful way of discovering the changes of the weather, the misapplication of a word will not I hope be considered as of much importance. When I add, that the Shepherd of Banbury's Rules for judging of the Weather should be examined, corrected, and extended, as an additional and important supplement to this plan, it may with propriety be intitled meteorological.

On the Preparation, Culture, and Use of the Orchis Root.

By J. PERCIVAL, *M. D.*

From HUNTER'S GEORGICAL ESSAYS.

SALEP is a preparation of the root of Orchis, or Dog-stones, of which many species are enumerated by botanical writers. The *Orchis mascula Linn. sp. pl.* is the most valued, although the roots of some of the palmated sorts, particularly of the *Orchis Latifolia*, are found to answer almost equally well. This plant flourishes in various parts of Europe and Asia, and grows in our country spontaneously, and in great abundance. It is assiduously cultivated in the East; and the root of it forms a considerable part of the diet of the inhabitants of Turkey, Persia, and Syria. A dry, and not very fertile soil is best adapted to its growth. An ingenious friend of mine, in order to collect the seed, transplanted a number of the Orchises into a meadow, where he had prepared a bed well manured for their reception. The next spring few of them appeared, and not one came to maturity, their roots being black and half rotten. The same gentleman

tleman informed me that he had never been able to raise any plants from the seed of the wild Orchis; but he ascribes his want of success to the wetness of the situation in which he resides. I have now before me a seed pod of the Orchis, the contents of which, to the naked eye, seem to be seed corrupted and turned to dust; but, when viewed through a microscope, appear evidently to be organized, and would, I doubt not, with proper culture, germinate, and produce a thriving crop of plants. The properest time for gathering the roots is when the seed is formed, and the stalk is ready to fall, because the new bulb, of which the salep is made, is then arrived to its full maturity, and may be distinguished from the old one, by a white bud rising from the top of it, which is the germ of the Orchis of the succeeding year.

Several methods of preparing salep have been proposed and practised. Geoffroy has delivered a very judicious process, for this purpose, in the *Histoire de l'Academie Royale des Sciences*, 1740; and Retzius, in the Swedish Transactions, 1764, has improved Geoffroy's method. But Mr. Moult, of Rochdale, has lately favoured the public with a new manner of curing the Orchis root: and as I have seen many specimens of his salep, at least equal, if not superior, to any brought from the Levant, I can recommend the following, which is his process, from my own knowledge of its success. The new root is to be washed in water, and the fine brown skin which covers it is to be separated by means of a small brush, or by dipping the root in hot water, and rubbing it with a coarse linen cloth. When a sufficient number of roots have been thus cleaned, they are to be spread on a tin-plate, and placed in an oven heated to the usual degree, where they are to remain six or ten minutes, in which time they will have lost their milky whiteness, and ac-

quired a transparency like horn, without any diminution of bulk. Being arrived at this state, they are to be removed, in order to dry and harden in the air, which will require several days to effect; or, by using a very gentle heat, they may be finished in a few hours *.

Salep, thus prepared, may be afforded, in this part of England, where labour bears a high value, at about 8d. or 10d. per lb. And it might be sold still cheaper, if the Orchis were to be cured without separating from it the brown skin which covers it;—a troublesome part of the process, and which does not contribute to render the root either more palatable or salutary. Whereas the foreign salep is now sold at 5s. or 6s. per lb.

The culture of the Orchis, therefore, is an object highly deserving of encouragement from all the lovers of agriculture. And as the root, if introduced into common use, would furnish a cheap, wholesome, and most nutritious article of diet, the growth of it would be sufficiently profitable to the farmer.

Salep is said to contain the greatest quantity of vegetable nourishment in the smallest bulk. Hence a very judicious writer, to prevent the dreadful calamity of famine at sea, has lately proposed that the powder of it should constitute part of the provisions of every ship's company. This powder and portable soup, dissolved in boiling water, form a rich thick jelly, capable of supporting life for a considerable length of time. An ounce of each of these articles, with two quarts of boiling water, will be sufficient subsistence for a man a day †; and, as

* Vid. A Letter from Mr. John Moult to the Author, containing a new method of preparing salep.—Phil. Transact. vol. 59.

† Portable soup is sold at 2s 6d. per lb.; salep, if cultivated in our own country, might be afforded at 10d. per lb.; the day's subsistence would therefore amount only to 2½d.

being

being a mixture of animal and vegetable food, must prove more nourishing than double the quantity of rice-cake, made by boiling rice in water. This last, however, sailors are often obliged solely to subsist upon for several months, especially in voyages to Guinea, when the bread and flour are exhausted, and the beef and pork, having been salted in hot countries, are become unfit for use *.

But, as a wholesome nourishment, rice is much inferior to salep. I digested several alimentary mixtures prepared of mutton and water, beat up with bread, sea-biscuit, salep, rice-flour, sago-powder, potatoe, old cheese, &c. in a heat equal to that of the human body. In forty-eight hours they had all acquired a vinous smell, and were in brisk fermentation, except the mixture with rice, which did not emit many air bubbles, and was but little changed. The third day several of the mixtures were sweet, and continued to ferment; others had lost their intestine motion, and were sour; but the one which contained the rice was become putrid. From this experiment it appears that rice, as an aliment, is slow of fermentation, and a very weak corrector of putrefaction. It is therefore an improper diet for hospital patients; but more particularly for sailors, in long voyages, because it is incapable of preventing, and will not contribute much to check the progress of that fatal disease, the sea-scurvy †. Under certain circumstances, rice seems disposed

* Vide Dr. Lind's Appendix to his Essay on the Diseases of Hot Climates.

† Cheese is now become a considerable article of ship provisions. When mellowed by age, it ferments readily with flesh and water, but separates a rancid oil, which seems incapable of any further change, and must, as a septic, be pernicious in the scurvy; for rancidity appears to be a species of putrefaction. The same objection may be urged,

posed of itself, without mixture, to become putrid; for by long keeping, it sometimes acquires an offensive fœtor; nor can it be considered as a very nutritive kind of food, on account of its difficult solubility in the stomach. Experience confirms the truth of this conclusion: For it is observed by the planters in the West Indies, that the negroes grow thin, and are less able to work whilst they subsist upon rice.

Salep has the singular property of concealing the taste of salt-water *; a circumstance of the highest importance at sea, when there is a scarcity of fresh water. I dissolved a drachm and half of common salt in a pint of the mucilage of salep, so liquid as to be potable, and the same quantity in a pint of spring water. The salep was by no means disagreeable to the taste, but the water was rendered extremely unpalatable.

This experiment suggested to me the trial of the Orchis root as a corrector of acidity; a property which would render it a very useful diet for children. But the solution of it, when mixed with vinegar, seemed only to dilute, like an equal proportion of water, and not to cover its sharpness.

Salep, however, appears by my experiments, to retard the acetous fermentation of milk, and consequently would be a good lithing for milk pottage, especially in large towns, where the cattle, being fed upon sour draff, must yield acescent milk.

Salep, in a certain proportion, which I have not yet been able to ascertain, would be a very useful and pro-

urged, with still greater propriety, against the use of cheese in hospitals; because convalescents are so liable to relapses, that the slightest error of diet may occasion them. Vide Percival's Letter to Mr. Aikin. —Thoughts on Hospitals, p. 95.

* Vide Dr. Lind's Appendix.

fitable

fitable addition to bread. I directed one ounce of the powder to be dissolved in a quart of water, and the mucilage to be mixed with a sufficient quantity of flour, salt, and yeast. The flour amounted to two pounds, the yeast to two ounces, and the salt to eighty grains. The loaf when baked was remarkably well fermented, and weighed three pounds two ounces. Another loaf, made with the same quantity of flour, &c. weighed two pounds and twelve ounces: from which it appears that the salep, though used in so small a proportion, increased the gravity of the loaf six ounces, by absorbing and retaining more water than the flour alone was capable of. Half a pound of flour and an ounce of salep were mixed together, and the water added according to the usual method of preparing bread. The loaf, when baked, weighed thirteen ounces and a half; and would probably have been heavier, if the salep had been previously dissolved in about a pint of water. But it should be remarked, that the quantity of flour used in this trial was not sufficient to conceal the peculiar taste of the salep.

The restorative, mucilaginous, and demulcent qualities of the Orchis-root render it of considerable use in various diseases. In the sea-scurvy it powerfully obtunds the acrimony of the fluids, and at the same time is easily assimulated into a mild and nutritious chyle. In diarrhœas and the dysentery, it is highly serviceable, by sheathing the internal coat of the intestines, by abating irritation, and gently correcting putrefaction. In the symptomatic fever, which arises from the absorption of pus, from ulcers in the lungs, from wounds, or from amputation, salep, used plentifully, is an admirable demulcent, and well adapted to resist that dissolution of the crasis of the blood, which is so evident in these cases. And

And by the same mucilaginous quality, it is equally efficacious in the strangury and dysury; especially in the latter, when arising from a venereal cause; because the discharge of urine is then attended with the most exquisite pain, from the ulcerations about the neck of the bladder, and through the course of the urethra. I have found it also an useful aliment for patients who labour under the stone or gravel *.

From these observations, short and imperfect as they are, I hope it will sufficiently appear that the culture of the Orchis root is an object of considerable importance to the public, and highly worthy of encouragement from all the patrons of agriculture. That taste for experiment, which characterises the present age, and which has so amazingly enlarged the boundaries of science, now animates the RATIONAL FARMER, who fears not to deviate from the beaten tract whenever improvements are suggested, or useful projects pointed out to him. Much has been already done for the advancement of agriculture; but the earth still teems with treasures which remain to be explored. The bounties of Nature are inexhaustible, and will for ever employ the art, and reward the industry of man.

* The ancient chymists seem to have entertained a very high opinion of the virtues of the Orchis root, of which the following quotation from the SECRETA SECRETORUM of Raymund Lully affords a diverting proof. The work is dated 1565.

SEXTA HERBA.

Satirion.

" Satirion herba est pluribus nota, hujus radicis collecta ad pondus lib. 4. die 20 mensis Januarij, contunde fortiter et massam contusam pone in ollam de aurichalco habente in cooperculo 20 foramina minuta sicut athomi, & pone intus cù prædicta messa lactis vaccini calidi sicut mulgetur de vacca lb. 3. et mellis libram 1. vini aromatici lb. 2. et repone per dies 20. ad solem et conserva et utere."

" Istius itaq; dosis ad pondus 3. 4. et hora diei decima exhibita mulieri post ipsius menstrua eadem nocte cõcipiet si vir cum ea agat."

Description

Description of an Apparatus for extinguishing Fires which may happen in Cotton Factories, &c. to be attached to Steam-Engines or Water-Mills.

Communicated by the Author, in a Letter to the Editors.

With a Plate.

THE great fires which frequently happen in cotton factories have made me (who live adjoining to one) very uneasy, and caused me to turn my thoughts to a plan for the extinguishing of them at the beginning. Various are the methods made use of by different manufacturers, which are all of them very proper precautions. In some factories, tubs of water, with wet blankets in them, are placed in each room, ready to throw on the place where the accident may happen. In other factories, besides this precaution, cisterns are placed at the top of the building, with pipes and cocks into every room, by which the floors may be covered with water almost instantaneously. If these or similar methods should fail of the desired effect, and if extinguishing-engines cannot be brought in time, the building must inevitably be consumed. Those persons who work the machinery with steam-engines or a water-wheel, might attach to some part of the work an extinguishing-engine, which of course would have prodigious power. Mr. Peter Marsland, of Stockport, has attached one to his water-wheel, which is placed in the centre of a square, surrounded with cotton factories. In the same manner an extinguishing-engine might be attached to the working beam of a steam-engine; but as these methods are attended with considerable expense, few persons choose to have them.

The plan which I propose would be attended with little expense, would nearly answer the same end, and

 would

would sooner be set to work; which, at the beginning of a fire, is of very great importance.

The annexed plan is suited for those who work with Boulton and Watts's patent engines.

Fig. 1 is the plan of a cistern, &c. in the common mode of working.

Fig. 2 is the same plan, with the addition of the air vessel or fire-engine.

References to Plate XI.

Fig. 1, A, the cold water cistern.

B, the pump which brings the air and water out of the condenser, commonly called the air-pump.

C, the piston-rod, which works in the air-pump through a stuffing-box.

D, the communication between the air-pump and the hot water cistern.

E, a valve through which the water passes into the hot water cistern.

F, the hot water cistern.

G, the hot water pump.

Fig. 2, H, the communication between the air-pump and the air vessel or engine for extinguishing fire, with a valve at the end K, through which the water passes into the air-vessel.

K, the air-vessel.

L, the pipe through which the water is forced by the compression of the air.

M, an elbow joint to which the leather pipes are attached.

N, the leather pipes, which may be lengthened so as to play into any room of the building, which is worked by the steam-engine.

O, the branch-pipe.

P,

P, a cock, which is opened into the hot water cistern, through which the water passes when the steam-engine is at work.

When the fire-engine is wanted to work, this cock is shut, and the water having no other way to escape is forced, by the compression of the air, up the tube, at a very considerable velocity. All the water which is pumped up by the jack-pump may by this machine be forced through the branch-pipe, which must in all probability extinguish any fire at the beginning, when the quantity of water brought up by the jack-pump is from thirty, forty, fifty, sixty, or seventy gallons *per* minute, according to the power of the engine.

Method of converting into Ether almost the Whole of any Quantity of Alkohol, by mixing three Parts of that Liquid with one Part of Sulphuric Acid.

By M. Van Mons.

From the Journal de Chimie.

I DISCOVERED by accident a method of converting into ether almost the whole of any quantity of alkohol without employing above one part of sulphuric acid to three parts of the former liquid. I was led to this discovery by the following circumstance.

I had mixed at three times, in a stone pan, four pounds of sulphuric acid with nine pounds of alkohol, intending to make ethereous alkohol with sulphuric acid (the mineral anodyne liquor of Hoffman). The alkohol marked thirty-four degrees on Baumé's areometer. The retort which I had at hand not being large enough to contain the whole of the mixture, I at first submitted only half of it to distillation. The operation was performed by a

 heat

heat that produced a slight ebullition. The remaining portion was poured on the residue in the retort, and distilled as before. The produce of the distillation was about three-fourths of the whole quantity.

The other fourth consisted of two different liquids; one of these, to the quantity of eight-ninths, was uppermost. This supernatant liquor was ether, and that underneath consisted of water mixed with ethereous alkohol.

This extraordinary formation of ether made me desirous of knowing the quantity of that liquid contained in the first distilled liquor. I therefore added a quantity of water to a few ounces of that liquor, and I observed that almost the whole was converted into ether. I then added water to the total quantity, and obtained above three pounds more of it.

It was natural to attribute this abundant production of ether to the presence of the acid in the residue left in the retort, or to the co-operation of the residue of the first distillation in the second. Wishing to see to what length this production of ether might be carried, by the same method, I poured the liquor of the first distillation, which yielded no more ether by the addition of water, upon the total residue, and distilled it with a strong ebullition; by this second operation above half of the ethereous alkohol was converted into ether.

Besides furnishing an almost incredible quantity of ether, this process possesses the advantage of saving three-fourths of the acid usually employed in preparing that liquid.

The pouring off of liquor produced by a single distillation, affords no ether separable by means of water from the total quantity of liquor. But this practice, together with a previous digestion of the distilled liquor, with a new fourth part of sulphuric acid, converts almost the whole into ethereous alkohol or ether.

From

From this result, and the consideration that the ether is not formed till towards the conclusion of the distillation, it appears that ethereous alkohol is not a mixture of alkohol and ether, but ether in an imperfect state, semi-etherified alkohol or semi-ether.

The abundant production of ether, in the operation I have here described, will tend to correct the erroneous opinion, that the alkohol of grain is less proper than that of the grape for furnishing ether.

Method of speedily producing Fruit from Trees inclined to run to Wood, of obtaining fine Shoots, and increasing the Strength of Timber-Trees.

By A. G. M. SURIRAY DELARUE.

From the JOURNAL PHYSICO-ECONOMIQUE.

THERE are few Horticulturists who have not the mortification to see in their orchards a number of fruit-trees of the apple kind, that push out abundance of vigorous branches, but yet constantly remain barren, notwithstanding the luxuriance of their growth. To remedy this defect, it has been recommended to bore a hole in the trunk of the tree and to put into it a wooden peg, or to dig at the foot of the tree and cut off one or more of the large roots. This troublesome process, however, has been attended with very uncertain success, and has therefore been but little practised.

These methods, in fact, are incapable of curing the evil, because it is not the superabundance of ascending sap that disposes trees to run to wood and causes the blossoms to fall off; but the too great elasticity of the bark of the tree while still young, that suffers the whole of

of the descending sap to proceed to the roots, to augment their growth and to form new teguments between the wood and the bark. When these vigorous trees have attained such an age, that their bark has acquired strength and solidity, then the sap, interrupted in its circulation while descending, remains in part among the branches, strengthens the blossoms, nourishes the fruit, increases its size, and advances its maturity. It is evident that if the sap can be retained by artificial means we shall obtain the same end, which is effected by nature only after a considerable number of years; the tree will be rendered fruitful. The most certain method of producing this effect is the annular excoriation.

Buffon was led to the discovery of this process so important to agriculturists by the following circumstance. Having read in Vitruvius, that "before trees are felled a hole ought to be bored at the bottom of the trunk to the centre, and that they should then be suffered to dry standing, after which they are much better for immediate use;" and finding in Plot's Natural History that "in the neighbourhood of Stafford it is usual to strip off the bark of trees near the root at the time when they are full of sap; that they are then left standing till the following winter, by which means the outer part of the wood becomes harder, and may be employed for the same purposes as the heart:" — the Pliny of France resolved to make some new experiments on this subject.

He, therefore, in May 1733, directed the trunks of a number of oaks of different ages and sizes to be stripped of the bark: and at the same time from a like number of trees of a similar description, he cut away the bark round the whole circumference of each for the space of three inches, at the distance of a yard from the ground. The results of this experiment were as follow: From the upper

per edge of the wounds, both of the trees that had been stripped, and those with the annular excoriations, proceeded a thick cushion-like substance or skin, which extended about an inch downwards during the first summer. In the young trees this substance was of greater extent than in the old ones.

Those trees whose trunks had been entirely stripped, lived a longer or shorter time in proportion to their strength; the youngest perished the first year, and the most vigorous lived till the end of the fourth. The above-mentioned substance or skin did not extend any farther after the first year, but only swelled a little. I shall now proceed to the effects of this operation.

The solidity, strength, weight, and hardness both of the inner and outer wood of the trees that had been stripped were considerably increased. The tegument between the wood and the bark, and which in the ordinary course of nature is not converted into perfect wood till the end of fifteen years, had become harder than the heart of the best common timber. The outside of this tegument was stronger than the inside, while the contrary is generally the case, as its density diminishes the nearer it approaches to the bark.

I must refer to Buffon's Memoir * for a more detailed account of these experiments, from which results this important fact, that by thus stripping off the bark, double the quantity of wood may be obtained from a tree to what it furnishes by the usual practice; and that by this same method a tree forty years old may be used for purposes, for which otherwise we are obliged to employ one of sixty years. The wood of those trees of which only three inches of the bark had been cut away, was

* Memoirs of the Academy of Sciences for the year 1738.

harder

harder than common wood, but was inferior in strength one-fourth to those which had been entirely stripped.

I think I recollect having read in some work, that this method of peeling standing timber trees prevents the wood from being liable to be worm-eaten.

Buffon made the same experiments on fruit-trees. Besides the appearances described above, he observed that those trees were covered, the second and succeeding years, with a greater number of flowers, and at an earlier period than they would have produced without this annular excoriation. That great naturalist judging that the interruption of the course of the descending sap, occasioned by his operations, could alone be the cause of the extraordinary increase in the number of blossoms upon these trees, thence drew this conclusion, that all the operations capable of producing this interruption would be the proper means of hastening the season of fecundity of fruit-bearing plants, and of producing fruit from sterile trees, which shoot out an exuberance of wood and nothing else.

It is unnecessary to state, that the following observations relate neither to the stone-fruit trees, nor those which like them produce the more fruit, the more they run to wood; they apply only to apple-trees, and those which like them do not become fruitful till age has, to a certain degree, checked the luxuriance of their vegetation.

Manner of making the Annular Excoriation to render fruitful such Trees as are apt to run to Wood.

1. To make this annular excoriation with a view to render fruitful a tree of this description, the early days of spring should be chosen; the sap having then begun to rise, the bark no longer adheres to the wood.

2. Cut

2. Cut away a slip of the bark of the trunk just below the branches, if you wish the whole tree to bear, or at the bottom of any particular branch that you may chuse to render productive. Attention must be paid not to leave upon the wood thus stripped of the bark, any portion of the interior teguments of the bark called *liber*. I have found by experience that on trees, one decimetre in diameter, the annular excoriation should not be made above 7 or 8 millemetres in breadth, that it may heal before autumn. On branches four or five centimetres in diameter take away no more than three or four millemetres, and so in proportion either for apples or stone-fruits, when you want to hasten the time of their ripening. An apple-tree requires a narrower excoriation than a pear-tree, and the quince a still narrower than the former.

3. Branches less than two decimetres, in diameter, on which an excoriation of this kind has been made, are very liable to be broken in that part by the least bending or agitation. It is therefore useful to strengthen them by means of a strong stick tied at a little distance above and below the wound.

4. If the wound be made on the trunk of a tree, care must be taken to break off all the shoots that appear below it, otherwise the ascending sap taking its course into them, the head of the tree will languish for want of nourishment.

5. A few days after the removal of the bark, from the upper extremity of the annular wound, between the wood and the bark issues a production at first succulent, glutinous, soft, and herbaceous, which hardens by degrees, assumes the colour of the bark, and forms all round the tree a ring of a semicylindrical figure, that is closely attached to the wood.

 This

This ring or skin continues to extend over the surface of the denuded wood, without, however, adhering to it. When the wound is not too wide it reaches the lower edge, and the wound is cicatrised in the first year: the tree is then safe. The increase of this ring after the first two or three months is almost imperceptible. If the wound has been made too wide; and the skin has not united with the lower bark, the circulation of the descending sap is prevented, and before the fourth year the wound will kill all the wood that is above it. No apprehension of this kind needs to be entertained if, in cutting away the bark, the proportions I have already mentioned be observed.

6. If in the second year the tree or branch upon which the operation has been performed, is not covered with a sufficient quantity of fruit-buds, make in the spring a new excoriation either on the same place as that of the preceding year or in any other. In case of necessity it may be repeated at the beginning of each succeeding spring, till the tree or branch is found sufficiently fruitful.

There will seldom be occasion to repeat the operation. The first wound is usually efficacious, and the tree plentifully covered with fruit the second year.

7. If the operator be fearful of making the wound too large, and that it will not be closed before autumn, he may make it very narrow, and if before the month of Messidor the new ring or skin have reached the edge of the lower bark, a little more of the latter may be taken away, at the same time recollecting that the increase of the skin is extremely small after the two first months.

This process employed in the manner, and with the precautions which I have stated, is infallible, speedy in its effects, and not attended with any injury or inconvenience.

8. In

8. In pruning fruit-trees it is of no use to cut out the luxuriant wood, or to endeavour, by means of pruning, to divert the sap. They should be suffered to grow freely for a year, but the following spring the bark may be cut away at the base of each of these branches; and thus by interrupting the course of the descending sap, you will obtain from them excellent shoots, and frequently fine early fruit.

9. When a shoot is grafted, the sap which it contains descends, and forms at the bottom a skin which issues from between the wood and the bark. On this skin rise small protuberances, each containing a ligneous fibre proceeding from the stem of the shoot; this fibre increases in length and becomes a root. Substances of a drying nature frequently kill the shoot during its temporary exhaustion by the descent of the sap, for the formation of the skin and roots, and before those roots have derived nourishment from new juices. If only such shoots be grafted which have the skin already formed at their base, the roots will strike out sooner, the shoots will not be so long deprived of sap, and they will be sure to thrive, being only a short time exposed to the action of destructive matters.

Conformably with this principle, in the spring of the year 9, (1801,) I grafted several branches which I had left on an apple tree trained as an espalier. In the spring of the year 10, (1802,) the grafts had grown very much, and the branches had increased, so as to be two centimetres in diameter. From the bottom of each I took away the bark for the space of two centimetres, not wishing the wound to cicatrise. A skin about three millemetres in breadth was formed on the upper edge, and the same year the branches bore a great quantity of apples,

which would have ripened had they not been blown off by a violent wind.

These branches are two metres in length, and have shoots branching out from their tops; I cut them this autumn, (1803,) below the ring of skin, taking care not to injure it, and planted them without taking off any of the small branches. They are very green, the buds are already large, and I hope they will form standard trees.

This process of the annular excoriation may be employed with success, to hasten the maturity of grapes a fortnight or three weeks, and to ripen grapes trained on a trellis, which frequently remain unripened to the end of the season.

The fruits of trees or branches on which this operation has been performed, are always earlier by fifteen or twenty days, and larger, than those produced by trees that have not been subjected to the operation. May not this be the method employed by the hoary philosopher described by Virgil? He had discovered the secret of obtaining the earliest roses in spring, and the earliest fruits in autumn.

Primus vere rosam atque autumno carpere poma. GEORG.

In confirmation of the above statements, I shall relate some of the experiments which I have made. As the subjects of them I selected healthy trees 14 or 15 years old, planted in open ground in a light and rather damp soil, some of which had several times flowered, but never borne any fruit, most of them never having produced buds for fruit.

It was in the spring of the year 9, (1801,) that I made all the annular excoriations, of which I am about to state the results.

Experiment

Experiment I. On the 12th Messidor, year 10, (1802,) I gathered ten very juicy and perfectly-ripe apricots from a branch of a tree submitted to the operation. At that time the apricots on the rest of the espalier were still small and green, and the earliest were not ripe before the 30th Messidor. The branch, from which I had pared the bark, was four centimetres in diameter; it bore twice as many apricots as other branches of the same espalier of equal magnitude; its fruit was one third larger and earlier than that of the rest of the tree by 18 days.

Experiment II. In the spring of the year 9, (1801,) I pared away the bark from the bottom of one out of two branches, forming the head of a standard apple-tree. The other branch of equal extent and thickness with the first, and forming the other half of the tree, was not submitted to the experiment. That year, like all the preceding, without exception, there was no fruit on either of the branches.

In the spring of the year 10, (1802,) the young shoots were nearly of equal size on both the parts of the tree, and I cut out none of them.

On the 20th Messidor, upon that part of the tree subjected to the experiment there were thirty apples, principally on the young branches which bent beneath the weight. One of these apples taken at random weighed nine ounces; the only apple that was at the same time on the other side of the tree weighed only two ounces.

The young branches on that side of the tree not submitted to the operation, had grown one-third larger and thicker than those on the side where the excoriation had been made.

Experiment III. On a very healthy apple-tree that had never borne fruit, and was divided into four branches equal in thickness and extent, I made in the year 9, (1801,) two

two annular excoriations on two of the branches. That year there was no fruit because there were upon the tree no fruit-buds formed the preceding year. The young wood grew nearly equally on all the branches of the tree.

In the spring of the year 10, (1802,) I pruned one of the branches on which I had made the annular excoriation and one of the others, leaving the new wood on the two remaining branches.

I observed: 1. That the branch submitted to the operation, and pruned had produced very few shoots, and that these were both short and small. The branch not submitted to the operation and pruned, had produced a great number of vigorous shoots.

2. The young shoots, left on the other branch submitted to the operation, had increased very little in their dimensions; while those of the branch on which I had not operated had grown very much.

3. The two branches, not submitted to the operation, produced no fruit; of the two other branches, that which had been pruned bore fewer apples than that not pruned, the young shoots of which were covered with fruit.

Experiment IV. In the year 9, (1801,) I made an annular excoriation on a branch of a pear-tree trained as an espalier; but did not meddle with the other branch forming the other half of the tree. The same year the increase of fruit was considerable. The 10th Thermidor, year 10, (1802,) from the part submitted to the operation I gathered pears perfectly ripe, weighing four ounces each, while those from the other half of the tree weighed no more than one ounce and a half. On the former, the number of pears that ripened was 84; the latter produced only 9 small ones, which dropped off before they arrived at perfect maturity.

It

[redacted]

It is necessary to remark, that there were as many blossoms on one side of the tree as on the other; but that those on the side where the excoriation was made were all fruitful, while almost all those on the other side fell off.

I think it superfluous to weary the reader with a greater number of facts, as the above will suffice to demonstrate the efficacy of the process here recommended.

Process for extracting Soda from Minerals.

From Klaproths's Analysis of Mineral Substances.

THE analysis of sonorous porphyry (*klingstein*) forms the subject of a memoir read by M. Klaproth to the Academy of Sciences of Berlin the 25th June 1801. The author begins by observing how little attention has been paid to the analysis of the most common mineral substances by those chemists who have devoted their labours to that kind of research, though the knowledge of their composition is highly important to the science of Natural History. He then enters into some interesting details relative to the history of the mineral, of which he is about to present the analysis; according to which it appears that Ferber and De Born considered it a variety, sometimes of argillaceous, sometimes of micaceous schistus; that M. De Charpentier was the first mineralogist who imagined that it was a distinct substance, to which he gave the name of *corneous schistus* (horn-schiefer); that M. Werner, having afterwards observed it with attention, discovered that its structure resembled porphyry, containing in its composition crystals of feldspath and hornblend, and that he gave it the name of *porphyric schistus*, because it might be separated into laminæ. M. Klaproth thinks

thinks this denomination should be changed; he therefore gives it a name taken from that of the mass, which constitutes this porphyric rock; he calls it *klingstein porphir*, that is, porphyry with a basis of sonorous stone.

The specimen of the klingstein which M. Klaproth employed for this analysis, was taken from the mountain of Millischau, in Bohemia. When ignited for half an hour, it lost three *per cent* of its weight; its colour, originally of a greenish-grey, became a whitish-grey. In a porcelain-furnace it was fused into a thick vitreous matter.

The author then enters into the details of the analysis; the results of which are:

Silex	57,25
Alumine	23,50
Lime	2,75
Oxyd of iron	3,25
Oxyd of manganese	0,25
Soda	8,10
Water	3,00
Loss	1,90
	100

The specific gravity was equal to 2,575.

This analysis led M. Klaproth to his ingenious manner of extracting the soda existing as a component part in certain mineral substances. The following is the process by which he effects that purpose.

"One hundred grains of very pure klingstein were pounded with 400 grains of nitrate of barytes; the mixture being put into a porcelain crucible, was at first exposed to a moderate fire, which was gradually raised to a red heat; when the bubbling ceased I increased the degree of heat; but upon uncovering the crucible I observed

served some thick whitish vapours rising from amidst the viscous matter, and apprehensive that the soda was escaping in a volatile form, I slackened the fire.

"The matter when cold was of a light blue colour, porous like a spunge, and very friable; when dissolved in muriatic acid diluted with a large quantity of water, I obtained a solution of a yellow colour, and perfectly limpid; this I put into a porcelain retort, upon a sand-bath, and gradually added so much sulphuric acid that there was sufficient not only to precipitate the barytes, in the form of sulphate, but likewise to predominate perceptibly, after having entirely disengaged the muriatic acid.

"The evaporation was continued to a moderate degree of dryness; the residue was diluted in water; the sulphate of barytes and silex which remained at the bottom were separated by the filtre; and the solution, which was limpid, was saturated and precipitated with ammoniac. The sediment that was formed was again separated by the filtre, and the solution evaporated to dryness. The saline residue, thus obtained, was put into a porcelain crucible, and exposed to a moderate degree of heat till all the sulphate was evaporated. The fixed part, that which remained in the crucible, was diluted with water, and afterwards crystallized; the crystals were pure sulphate of soda. This salt was again dissolved, and afterwards decomposed by acetite of barytes; a sulphate of barytes was precipitated, separated by the filtre, and the solution evaporated to dryness. The acetite of soda was exposed to a red heat in a crucible of platina; the coaly residue dissolved in water and filtered, furnished a ley, clear and colourless, from which were extracted, by evaporation, 14 grains of carbonate of soda, yielding $8\frac{1}{10}$ grains of pure soda. Dissolved in nitric acid, and left to

 crys-

crystallize, it formed crystals of nitrate of soda of a rhomboidal form.

"The quantity of soda contained in the klingstein may be regarded as rather greater than what I have here stated; because, besides the loss inevitable in the operations through which any substance that is analysed must necessarily pass, the thick filamentous vapours that escaped when I uncovered the crucible in which I ignited the mineral with the barytes, appeared to me to proceed from a volatilization of the soda."

M. Klaproth concludes his memoir with remarking the importance of the discovery of soda in a mineral substance, of which whole chains of mountains are composed: this alkaline substance is equal to one-twelfth in the composition of the klingstein. He observes that the mountain of Millischau alone, which is nearly a perfect cone, above 800 metres in height, would afford a supply of soda equal to the consumption of all Europe during a long series of years, if a convenient method of extracting it could be discovered.

Notice on several Processes, but little known, employed for gilding and silvering Metals.

From the Annales des Arts et Manufactures.

THE lustre of gold is pleasing to every eye; but this precious substance is so rare, that the arts have been obliged to resort to various methods of multiplying it in appearance, by slightly covering the most common metals with this costly material. Such is the origin of gilding.

For the purpose of gilding, the artizan either covers the metal directly with a leaf of gold, or he forms an amalgama

amalgama of gold and quicksilver, with which he rubs the metal, and afterwards volatilizes the quicksilver by means of heat.

The success of this operation depends in a great measure on the attention that is paid to render perfectly clean the surface of the metal which is to be united to the gold, because then the junction is more perfect. Silver, copper, brass, and pinchbeck, may be gilded with ease by the two above-mentioned methods; but steel and iron oppose many obstacles, and cannot be gilded in a permanent manner by any of the processes hitherto discovered. The reason is, that the surface of steel and iron cannot be kept perfectly clean during the operation.

Application of Leaf-Gold to Iron or Steel.

In this process it is necessary to begin with heating the metal upon which it is proposed to apply the gold. This circumstance requires particular attention on the part of the artist, for if he does not heat it enough he runs the risk of not obtaining a sufficient power of adhesion; and if he heats it too much he is liable to subject the metal to the commencement of oxydation, besides incurring the danger of destroying the temper of sharp instruments, as swords, daggers, &c. that are to be heated.

Of gilding with the Amalgama and Nitrate of Mercury.

The difficulty of the operation, and the danger of its failure, are augmented, if it is intended to gild iron or steel by means of the almalgama; for as the metal has no affinity with the mercury, an intermediate matter is required to dispose its surface to receive it. For this purpose the parts that are to be gilded are wetted with a solution of mercury in nitrous acid, which mordant is denominated by artists *mercurial water.* The acid, which has

 a greater

a greater affinity for the iron than for the mercury, attacks the former, and deposits a thin layer of mercury instead of that of iron, which it takes away. This layer effects the union of the amalgama which is then applied with the iron; which combination would not have taken place without it. But by this process the surface of the iron is injured by the action of the nitric acid, and the union is so slight that a brilliant and durable gilding can never be produced by this method.

Of gilding with the Amalgama and the Sulphate of Copper.

Sometimes with a camel-hair pencil a solution of sulphate of copper is applied to that part of the steel which is proposed to be gilded. By a chemical affinity, exactly similar to that just described, a thin layer of copper is precipitated upon the iron. The copper having an affinity for the mercury, is capable of serving as an intermediate substance, and effecting a kind of union between the amalgama and the iron.

But in both of these processes the surface of the steel is always injured by the action of the acid, and in both a degree of heat must likewise be employed sufficient to volatilize the mercury. In consequence of these disadvantages most artists adopt the first process, which consists in applying the gold-leaf to the metal when hot, and in fixing it by the action of the burnisher. This process is troublesome, but the surface of the iron is less liable to be injured by it.

Improved Process for gilding Iron or Steel.

This process, which is not so generally known among artists as it deserves to be, may be useful to those who are required to gild iron or steel. Into a solution of gold in nitro-muriatic acid pour about twice the quantity of ether; this

this mixture should be made with care, and in a large vessel. Shake the two liquids together, and as soon as the mixture has settled, the ether will be seen separating from the nitro-muriatic acid, and floating on the surface. The acid becomes colourless, and the ether acquires a colour, because it takes away the gold from the acid. The two liquids are poured into a glass funnel, the pipe of which must be very small, and must be stopped till the two fluids have settled, when they will be completely separated from each other. Being then opened, the acid which, on account of its weight, is lowermost, runs out the first; when it is entirely drawn off, stop the funnel, which then contains only the solution of gold in ether; this is put into a phial, well corked, and kept for use.

To gild iron or steel, first polish the surface with the finest emery, or rather with colcothar moistened with brandy. Then, with a small brush or pencil, apply the auriferous ether; the liquid soon evaporates, and the gold remains. Heat, and afterwards rub it with the burnisher. By means of this solution of gold in ether the artist may, with a pen or pencil, trace all kinds of figures upon iron, and we conceive that this is the method employed for plating the wares of Sohlingen. As every artist may not have at hand the receipts for the best method of preparing nitro-muriatic acid and ether, we shall here introduce both.

Method of preparing the Solution of Gold in Nitro-muriatic Acid.

Into a sufficient quantity of nitrous acid put as much sal-ammoniac as it is capable of dissolving cold, and even in a cool place. Into this acid put gold reduced to filings or thin leaves, and place it in a situation where it will become warm till the metal is completely dissolved. The solution

solution assumes a yellow colour, being that of the gold, and stains the skins of animals purple.

Method of preparing Sulphuric Ether.

Into a large retort put one pound and a half of highly-rectified spirit of wine, to which pour slowly two pounds of the most concentrated sulphuric acid, slightly agitating the mixture as you add the acid. The mixture will become warm, and the vapours that will be abundantly disengaged will have a pungent smell. When you have poured in all the sulphuric acid, add half a pound of spirit of wine, which will rince the neck of the retort on its passage, mix the whole well, and let it stand for some time, previously closing the mouth of the retort.

Place it afterwards on a sand-bath; adapt to it a large recipient, and kindle the fire: it should be slow and moderate, and the heat ought not to be communicated to the recipient. Continue the operation till a sulphuric smell is emitted from the globe of the recipient. Unlute and collect the produce, which is a mixture of ether, acidulated water, spirit of wine, sulphuric acid, and a carbonic matter.

To rectify this, put it again into a retort; and after adding a small quantity of alkali to absorb the acid, place the retort on the sand-bath, which heat very moderately; the first half of the liquid that passes over is extremely pure ether.

The residue of the first distillation may be employed to prepare a farther quantity of ether. It will be sufficient to pour upon it some good spirit of wine, but less in quantity by one-third than the first time; distil, rectify, &c.

Another

Another Process for the Purposes of gilding.

Those who may find a difficulty in preparing ether may substitute for that liquid an essential oil, as spirit of lavender, oil of turpentine, &c.: these liquids possess the property of separating gold from a nitro-muriatic solution.

Method of preparing Alkohol.

As it is frequently difficult to procure highly-rectified alkohol, this may be effected by employing the following process with weak spirit of wine.

Take potash, perfectly dry, and sprinkle it over the spirit of wine: the alkali will unite exclusively with the water, and the supernatant liquor will be the purest spirit of wine. Decant it, and repeat the same operation, till the potash ceases to contract moisture in the liquid. The alkohol becomes extremely pure, but it is coloured by the action of the potash. To take away this colour, distil it in a retort, with a gentle fire, and the first four-fifths will be perfectly-rectified spirit of wine.

Of gilding Silver cold.

Independently of the preceding methods, silver may be gilded cold, and with great ease, by means of the following process.

Dissolve some gold in nitro-muriatic acid, and dip linen rags in the solution. Burn the rags, carefully preserving the ashes, which will be very black, and heavier than common ashes. Rub them on the surface of the silver you intend to gild, for which purpose the finger, or a piece of leather or cork, may be employed. This action attaches the particles of gold to the surface of the silver: wash the latter, when you will perceive some slight traces of

of gilding; which will appear much more distinctly when rubbed with the burnisher.

Of gilding Brass.

The surface of delicate instruments made of brass may be preserved a considerable time uninjured, by gilding them in the following manner.

Procure a solution of saturated gold, and after having evaporated it to the consistence of oil, leave it to crystallize. Dissolve the crystals in pure water, and after plunging into this solution the articles that are to be gilded, wash them in pure water, and submit them to the action of the burnisher. Repeat the process till they are completely gilded. The solution of the crystals of nitro-muriate of gold is preferable to a simple solution of the metal, because the latter always contains a portion of acid at liberty, which attacks more or less powerfully the surface of the brass, and destroys its polish.

Method of varnishing Brass.

A varnish, very much resembling gilding, may be applied to brass, by covering it with a solution of gum-lac in spirit of wine. It preserves its brilliancy as long as the varnish lasts. The articles prepared in this way must not be rubbed with too hard a brush, or with chalk; they must only be wetted with linen-rags. This varnish is prepared in the following manner.

Dissolve two ounces of very pure gum-lac in forty-eight ounces of alkohol, and place the solution upon a sand-bath in a moderate heat. To prevent part of the spirit of wine from evaporating as well as the vessel from bursting, if too closely stopped, cover the neck with a bladder, in which several holes must be made with a pin. In another vessel, and in the same quantity of spirit of

of wine, dissolve an ounce of gum-tragacanth, in grains. Mix the two solutions when complete; put into it three grains of sanders wood, and let the whole stand for twelve hours in a moderate heat. Filtre through paper, and keep it for use in a very clean phial. Sanders wood is preferable to any other substance for giving a gold colour to the varnish made with lac. If you intend it to be pale, and not to alter the colour of the brass, omit this colouring principle; and if you want a darker yellow add half as much more wood as the quantity specified above.

Notice on the Dutch Method of salting Herrings.

From the Annales des Arts et Manufactures.

THE Dutch are acknowledged to understand the art of salting herrings better than any other European nation; therefore some account of their method of preserving those fish may not be deemed unacceptable.

As soon as the herrings are caught, the fishermen immediately proceed to pack them; preparatory to which they open the gills, and with the fore-finger and thumb, they pull out the entrails, liver, and stomach, together with the intestines and the fat membrane, which always adheres to them, but without separating the latter. They are then plunged into a strong brine of salt and water, and afterwards hung up till they have drained sufficiently dry.

When this operation is completed, they proceed to the packing, which consists in stowing them away in barrels as closely as possible, in layers, with a stratum of salt over every layer of herrings; taking care to place the fish

 of

of each succeeding layer in a contrary direction. The barrels are then closed. The greatest attention is paid to select such casks as are sound and well hooped, for if the air gets admittance the fish are spoiled. The herrings are thus left in salt a fortnight if fine salt has been employed, or three weeks, or a month, if it be of the coarse kind, by which time they are sufficiently impregnated.

Upon the return of the vessel to port, the barrels are immediately landed, and conveyed to the place where the process of curing is completed.

The subsequent operation is the most important part of the Dutch method, as it prevents the tendency of the liquor, charged with lymph and blood, to putrefy. It depends upon a process, by which the oil contained in the liquor being made to commix with the water, or reduced to a saponaceous state, is preserved from the action of the air, and is consequently less liable to become rancid.

When the herrings have been sufficiently stirred to disengage the lymph and blood from them, the barrels are emptied upon large tables or benches, provided with ledges, which are inclined in such a manner that the liquor which drains from them may run into a tub, placed underneath. This liquor is put into an iron pot, and boiled; during the ebullition the scum is taken off, and it is then emptied into a wooden vessel, where it is left to cool.

They then take the roes of thirty herrings for each barrel, and pound or triturate them in a stone mortar, mixing with them a small quantity of the liquor as the trituration proceeds, till they reduce it to the state of an emulsion, or a saponaceous liquor. This they pour into the liquor that has been boiled, and removed into the wooden vessel, and the whole is mixed together. The fish

fish are then packed in the barrel, where they are placed in the manner already described. When the cask is filled, the top is forced down upon the fish; for which purpose a press is employed, as well as to press down the herrings from time to time during the package. This pressure is useful for preserving them, and causes each barrel to contain one-third more than in the first operation. The liquor boiled and mixed as above is then poured in at the bung-hole till the cask is quite full; when the herrings cease to absorb any more liquor the bung is driven in, and the casks of herrings are ready for sale. The liquor is only used when cold.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

The following Observations, on the Introduction of improved Machinery in the Woollen Manufactory, are by Mr. JOHN ANSTIE.

IN the year 1791 serious apprehensions were entertained of the shearmen, and other persons employed in the woollen manufactory, committing fresh outrages on the property of those clothiers, in the county of Wilts, who at that time had more generally begun to scribble wool by machinery.

The contest between the clothiers of the counties of Wilts, Gloucester, and Somerset, and the work-people, is now brought to a crisis, by the application of the former to the legislature for a repeal of the obsolete laws respecting the woollen manufacture, particularly those on which the latter ground their opposition to the farther progress of machinery in diminishing labour.

 That

That the woollen business in the county of Wilts, in particular, is at present in a depressed state cannot possibly be denied; and no one, who feels himself in the least interested in its prosperity, can be insensible to the event of the present disputes between the clothiers and the work-people.

The introduction of almost all kinds of machines into the woollen manufactory in the county of York, without obstruction from the work-people, originated in very favourable circumstances, which, if necessary, could easily be pointed out; and the rapid increase of the manufacture, since the more general improvements of machinery in that county, must evince the superior benefits derived by those persons who are enabled to reap the advantages of ingenious discoveries for diminishing labour.

The little opposition made in the county of Gloucester, by the work-people, to the improvements in the manufacture, till the shearing frames were attempted to be introduced, must also be attributed principally to favourable existing causes, though the increase of the woollen trade of that county must perhaps be considered as originating principally in the superior mode of dressing superfine cloths.

Unfortunately, so far from there being any thing existing in the state of the county of Wilts, particularly favourable to the introduction of machinery, when the improved mode of spinning began to prevail, that circumstances of a local nature were peculiarly adverse to its being introduced into that county.

A large district of the county, where no manufactories were established, depended almost entirely on spinning of wool, carried there not only by the clothiers from Bradford, Trowbridge, Devizes, Melksham, &c. but even from some of the manufacturers in the counties of Gloucester

Gloucester and Somerset.—When, therefore, the far greater part of the clothiers ceased from carrying wool for spinning to that district, the spinners were thrown out of employ, and no previous measure having been taken, no adequate substitute could be found for the loss sustained by them.

Their situation at that time was truly distressing to the feelings of humanity;—and the warmest advocate for the introduction of machinery, if not absolutely destitute of all kind of commisseration for the sufferings of others, could not but be anxiously desirous of devising means for their being employed.

This, in all human probability, must have been the necessary consequence eventually, had not spinning by machinery, on the improved machines (as in fact the spinning turn, strictly speaking, must be considered as a machine), as well as scribbling and carding wool by different and more expeditious modes, been introduced into that county.

Though it would be easy to point out the beneficial consequences necessarily following the application of machinery in other branches, these observations will be confined more immediately to the woollen manufacture.

Respecting the probability of an increase in the annual product of wool, for forming an accurate opinion on the subject, it would be necessary to know the actual excess of the value of the raw material imported from Spain and other parts, within the period that was given in the accounts laid before the House of Commons.

To this must be added its additional value, by the expense incurred of manufacturing it.

If this total amount should not appear to be equal to the increased value of the exports (making proper allowance for the advance in price, as noticed before), in a certain

certain period, it would afford a pretty decided proof, that our native wool was actually increased in quantity, except it should be supposed our own internal consumption of woollen goods had been diminished *.

Though some allowance must be made for the advance in the price of goods, as before-mentioned, yet perhaps sufficient reliance may be placed on the account delivered to the House of Commons, from the Custom House, to afford general proof, that our native wool must have rather increased in quantity.

	£.	s.	d.
In the year 1799, the exports of woollen goods amounted to -	6,876,939	8	3
In the year 1790, they were only	5,190,637	13	6
Difference - - - -	£ 1,686,301	14	9

The account of the imports of foreign wools does not go back farther than 1791, but one year can make no material difference in this general view of the subject.

In the year 1792, the total amount of the import of Spanish and other foreign wools was - - -	4,935,839 lb. wght.
In the year 1791, it was - -	2,776,074
Difference - - - - -	2,159,765

As it is impossible to ascertain the proportion between the finer wools and others of the coarser quality imported, there are no means of making an accurate calculation of the actual value.

* Though the use of Norwich and other woollen stuffs has so much declined, yet there is not the least probable ground to suppose our internal consumption of woollen goods has been lessened. Most assuredly people in general consume more cloths than formerly, and the increased use of carpets, &c. must require an additional quantity of wool.

The

The writer therefore considers it to be fully sufficient to state his opinion, that the original value of the wool, and its increase in the price of manufacturing it, may be taken at about one million two hundred thousand pounds sterling.

	£.	s.	d.
The excess of the exports of woollen goods in 1799, compared with 1791, has been given as - -	1,686,301	14	9
Calculating the value of foreign wool, and the expense of manufacturing it, as stated above - -	1,200,000	0	0
The difference would be - -	£ 486,301	14	9

From the above statement it appears, the surplus of exported woollen goods in 1799, after deducting the value of foreign wool imported, and its additional amount by manufacturing, over and above what it was in 1791, amounted to not much short of five hundred thousand pounds.

If the premises are well-founded, the inference is incontrovertible, that though the import of foreign wool was so much increased from 1791 to 1799, yet the export of goods from our own native growth of wool greatly increased also.

Improvement in the Manufacture of Hemp and Flax.

By a report made to the Lyceum of Arts at Paris, on a new preparation of Hemp and Flax, invented by M. Lebrun, it is stated that he gives these materials an appearance perfectly new and advantageous, and obtains a kind of cotton and silk thread from them. He begins with the tow the moment it leaves the hands of the cultivator; he communicates to it either the soft and adhesive nature of cotton, or a brilliancy resembling that of silk. It

It may be carded and spun like cotton, and when woven appears perfectly similar to that material; it takes and preserves, in like manner, various colours, of the same degree of solidity, and is capable of assuming a lustre far superior. It is well known that it is difficult to dye thread even an indifferent colour; and that it has as little lustre as solidity. According to M. Le Brun's new method, its fibres appear to be in a new state because they possess new chemical properties.

Thus an indigenous plant, abounding in France, and always low in price, is capable by means of this discovery of being substituted for an exotic material, the cotton of Smyrna, which, though of inferior quality, is always higher in price; so that a proportionate difference must ensue between the value of manufactured cotton goods and those of materials of French production. This advantage will be accompanied with another, say the reporters, we shall be relieved from the apprehension of circumstances making cotton dear and scarce, which has frequently been occasioned in time of war, by the interruption of our communication with those countries which supply us with that article. These important considerations remove every doubt respecting the advantages which the nation will derive from the abundant production of this species of indigenous cotton. This abundance cannot be disputed, since, with the labour of a few individuals, 1000 lbs. of tow may, in 24 hours, be converted into cotton. The reporters therefore considered this preparation of the utmost importance, as the produce of it may be employed for a great variety of purposes. Of this they were convinced by the examination of 28 samples of hemp and flax in skeins, carded and manufactured by M. Lebrun. They observed a piece of cotton-velvet, a piece of shag, dyed six different colours;

lours; a piece of striped muslin, and a remnant of white muslin. The whole of these were composed of vegetable matters, and the most rigorous experiments have confirmed the success of the process.

A second preparation likewise affords resources to the industry of the country. In brilliancy and the fineness of its texture it rivals silk. The reporters convinced themselves that this silky appearance cannot be destroyed by the action of leys; they boiled several samples in potash, which is certainly the severest test; it was perfectly harmless, and the brilliancy remained unchanged. From this experiment it appears, that this material will be of extensive utility in the manufacture of a variety of small articles, and, as it is capable of taking different colours, it will be productive of the most advantageous effects. When dyed it assumes the appearance of silk, and yet retains the state of a vegetable substance. This remark is made, because if a portion of any stuff, of which silk composes a part, be burned, a smell of ammoniac is disengaged. The reader might hence be led into an error, or to suppose that this phenomenon had escaped notice; the only result is, that in the manufacture of those stuffs, silk has been employed either for the warp or for the stripes. This preparation will, therefore, be of infinite service to manufacturers, from the variety of ways in which it may be employed, while its price will in many instances cause it to be preferred to silk, part of the beauty of which it, at the same time, possesses.

Advantages of deep ploughing for Potatoes.

At Michaelmas, 1802, Mr. Gardiner, of Boldre, near Lymington, took possession of about eighty acres of arable land, that had been exhausted by a tenant. Sixty

acres had been under white corn five years successively, the last crop principally wheat, slight enough as may be supposed, and a full crop of every sort of trumpery. The soil is naturally a dry, deep, strongish loam. As soon therefore as rain enough had fallen to allow the plough to go the desired depth, Mr. Gardiner broke it up full ten inches deep, burying, by means of a skim-coulter, all the stubble and trumpery. In this state forty acres of it were left till the beginning of April. By the frosts the ground was crumbled quite fine, and there was not a very full appearance of weeds. It was laid in four-bout lands, of about six feet. The second week in April a double mould-board plough was run along the centre of each ridge, and had cuttings of the white globe potatoe, set about nine inches apart, by women and children following the plough. All the dung that could by any means be scraped together was taken from out a cart that went down the intervals, and was spread with a prong lightly and sparingly over the potatoes, and covered with earth by a common light plough.

About a hundred cart-loads of dung (of thirty bushels each) covered in this manner about thirty acres, and it took twelve bushels of potatoes an acre to plant it. For the remaining ten acres Mr. Gardiner had no dung, and therefore planted them the same way without it. During the summer he three times ploughed the six feet intervals, ran the scufflers twice down them, and once hand-hoed the rows of potatoes. Notwithstanding the dryness of the summer the haulm continued green and vigorous, and in the whole forty acres scarce a weed was to be seen. Having prepared a pit to store them in, and plenty of fern to cover them, Mr. Gardiner began to take them up the last week in September, and continued so doing to the first in November.. They were dug up with prongs, for

for which and picking he paid 2½ *d.* *per* bag, and sold them to a dealer from Portsmouth at 6 *s.* *per* bag, for the whole crop, great and small, delivered at Lymington Quay, about two miles distance.

The thirty acres dunged produced on the average 97 bags *per* acre, or 291 bushels. The ten acres undunged produced, to Mr. Gardiner's surprize, 82 bags *per* acre, or 246 bushels. Mr. Gardiner, in speaking of produce, says he means *produce sold*, for he received of Mr. Miller, of Portsea, 1,119 *l.* for 3,730 bags. Mr. Gardiner adds, that in the middle of December last, the whole forty acres were as clean as a garden, drilled at 11½ inches with wheat, and then in a very promising state.

The profit on these forty acres was 815 *l.* 4 *s.* 6 *d.* something more than 20 *l.* an acre. Mr. Gardiner attributes this great success almost intirely *to the deep winter-ploughing, a deep and good soil, formerly marled.*

Potatoes recommended for feeding Sheep.

It is stated by Mr. Bartley, of Bath, that in consequence of former experience, February, 1801, he began to feed a small flock of ewes, then in lamb, with potatoes, (raw and unwashed,) and that his shepherd was much surprised to find the ewes took to them with an astonishing degree of eagerness, after totally neglecting them for the two first days. That he continued to feed them every morning in the proportion of about 2¼ lbs. to each ewe; they would readily have taken more, but as they improved in condition very rapidly, Mr. Bartley feared it would endanger their lambing. As the lambs dropped they are supplied more liberally, to increase the milk. This practice Mr. Bartley thinks will become general wherever it is known: within the reach of his own observation some

 thou-

thousands of sheep are thus feeding. The advantage is real and substantial, at least under the existing circumstance of a prodigious surplus of potatoes, but in what proportion remains to be ascertained.

It would probably result from well-conducted enquiries of this nature, that the potatoe might generally be well substituted for the turnip. The crop is less precarious, suitable to a greater variety of soil, and to be secured against the variety of frosts with more certainty. Besides in those parts of the kingdom where the practice of hoeing is neglected, turnip crops are but of small comparative value.

Machine for measuring the Rapidity of Bodies discharged by Artillery.

At the meetings of the National Institute on the 13th and 20th of Frimaire (4th and 11th Dec.), M. Prony read a long and elaborate report on a machine, invented by Colonel Grobert, for measuring the rapidity of bodies discharged from artillery. This machine possesses the important advantage of firing with every calibre, and at every angle from zero to 45 degrees, and permits the use of every kind of frame. It is principally composed of two vertical, perforated disks, which turn round with great rapidity. They are mounted upon one common axis, and a skreen is fixed before each. The ball alternately passes through the skreens and the disks; but the hole in the second differs more or less from the direction of that of the first, according to the time which the projected body requires to traverse the space between them.

The Institute adopted the conclusions of Messrs. Prony, Monge, and Bossut, who were commissioned to examine this machine.

Account of Food consumed, and Weight gained, by Mr. Whittle's *Prize-Hog exhibited at Smithfield in December last.*

	Date.	Age.	Weight.	Weight gained.	Food eaten.		Food which gives 100 lbs. live flesh in 3 months.
1803.	Feb. 28.	6 months	161 lbs.				
	May 28.	9	348	187 lbs.	15¾	Bushels of Peas and Barley.	8½
	Aug. 28.	12	496	148	14		9½
	Nov. 28.	15	591	95	13		13¾
	Dec. 13.		595	4	1½		37½

The result of feeding this hog is remarkable, and proves the great importance of ascertaining the progression of weight gained from food given: the longer the hog is feeding the less he pays; but the loss of keeping too long does not fully appear in the last article, as it is supposed he would have proceeded for ninety days as he did for fifteen, but he would from the decline in these fifteen days probably have gained less and less.

Contrivance

Contrivance for warming Carriages.

M. Virginio, of Turin, has recently invented a machine for warming carriages. It is composed of three circular iron boxes; the first very thin in substance, ,38532 metres long, and ,12844 metres wide. This box is furnished with several feet, ,02140 metres in length; it is soldered together, and has a covering of iron which fits into, instead of upon it. The second box is ,47005 metres long, and ,42813 wide, and likewise has a lid which must fit exactly.

This lid has a rim outwards of about ,04231 metres, this space is filled with pulverized charcoal, and is closed by another lid.—The first box is introduced into the second, and in the space between them are put small pieces of iron to keep the first steady. The third is then filled with pulverized charcoal to the height of ,04280 metres; and upon this is placed the second box, the vacancy between the second and third being filled in the same manner with pulverized charcoal.

This vacant space must be closed at the top with a plate soldered over it, to prevent the charcoal from changing its position or getting out.

To these boxes three tubes must be previously adapted, one near the bottom to afford a passage to the external air into the first box; the second on the opposite side near the top, to conduct the air from the first box into the other two and out again. The three boxes are fixed by means of iron hold-fasts, or in any other way, to the bottom of the body of the carriage in front. These two tubes are enveloped in a larger tube, which is likewise filled with pulverized charcoal. This being introduced into the body of the carriage, the second tube projects behind it. Ignited charcoal is then put into the bottom of

of the first box, and the lids of all the boxes are shut down. As the carriage advances, the air enters in a violent current, by means of the first tube, into the first box; and keeps up the fire while the smoke is carried out by the second tube behind the carriage; the fire in the first box heats the air contained in the second, and that air is conducted by the third into the body of the carriage. The heat will be augmented by opening or shutting the first or the third tube, more or less, or by putting a greater or less quantity of charcoal into the first box, which may be done while the carriage is in motion.

For this purpose the charcoal of the hardest wood or stone-coal should be employed. The charcoal in the the third box prevents the heat from escaping in any other direction than by the third tube into the body of the carriage, and at the same time prevents the third box from becoming heated and injuring the carriage. The first box may even be made in such a manner as to hold a small pot for warming any kind of liquid.

New Earth called Agustine.

M. Vauquelin has examined the substance announced as a new earth by the name of *agustine*, which forms one of the component parts of the beryl of Saxony. From some experiments made on a specimen of this mineral, sent him by M. Karsten, he has ascertained that the agustine is no other than phosphate of lime.

Machine for shearing Cloth.

Messrs. Wathier and Leblanc Paroissien, of Rheims, lately invented a machine for shearing cloth. This machine has been since altered and improved by M. Leblanc, to whom the government has granted a patent, dated

dated 4 Brumaire, year 12, (October 26, 1803.) This machine is stated to be very simple, and the more advantageous as one man sets in motion eight powers, and these may be augmented by adapting to it any moving power whatever.

List of Patents for Inventions, &c.

(Continued from Page 240.)

JOHN WOOD, of Manchester, in the county palatine of Lancaster, Machine-maker; for his new-invented improvements or additions to machines for spinning cotton, silk, and wool. Dated January 10, 1804.

JOHN SLATER, of Huddersfield, in the county of York, Surgeon; for his new-invented improved method of manufacturing and fabricating of cables, shrouds, stays, and other articles for the rigging of ships, of materials never before used for that purpose. Dated January 19, 1804.

GEORGE ALDERSON, of Carnaby-street, in the parish of St. James, Westminster, in the county of Middlesex, Lead-pipe-manufacturer; for his new-invented manufacture of metal pipes, the same being lead, lined with tin, in a manner and by a process entirely new, to be used in all cases to which lead pipes are applicable. Dated January 26, 1804.

TO OUR READERS.

In the memoir on hardening copper, in our last number, p. 234, it is said that an alloy of copper with 30 *per cent.* of tin "forms an excellent composition for making looking-glasses, spectacles, or telescopes." This absurdity is a faithful translation from the French; and a note was prepared to point it out, but unfortunately omitted by the compositor. It may be reconciled by reading, "*an excellent composition for making mirrors and specula for telescopes.*"

THE REPERTORY OF ARTS, MANUFACTURES, AND AGRICULTURE.

NUMBER XXIII. SECOND SERIES. April 1, 1804.

Specification of the Patent granted to CLEMENT SHARP, *of the Parish of Saint Luke, in the County of Middlesex, Merchant, and* AMOS WHITTEMORE, *of the same Place, Card Maker; for an entire new Machine for the Purpose of making all Sorts of Cards for Carding Wool, Cotton, and all other Materials capable of being carded, and for dressing Woollen Cloths.*

Dated June 26, 1799.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, We the said Clement Sharp and Amos Whittemore do hereby declare that our said invention is described in manner following; that is to say: This invention consists in making, by a machine, all sorts and sizes of cards for carding of wool, cotton, and all other materials capable of being carded, and for dressing woollen cloths, for which purpose, until now, there had never been a machine in Great Britain, and is still thought to be impossible. The mode in which cards are at present made; viz.

viz. by first piercing all the holes in the piece of leather, and preparing the staples to be put into them singly by hand, must necessarily be confined to cards of a much smaller size than may be made by the machine. The crook in the staples is always liable to be altered, particularly in putting them through stout leather, which causes the cards to work unevenly, at the same time the holes in the leather must be larger than the staples, which not being properly supported lose a great part of their elasticity.

The cards made by the machine are free from these imperfections, as they may be made of any size with leather of any thickness, the holes the size of the staples which are all crooked exactly alike in any part and to any figure, with the greatest uniformity, and to a degree of fineness hitherto never attempted by hand, to the great improvement of the woollen and cotton manufactures. The powers of the machine are here specified: The leaf or piece of leather is put into the stretching frame, and by its different motions every part of it is brought alternately to a given point in the centre of the machine, which if a tracer would draw upon it any pattern which is or can be made, it is then set to the desired pattern, and one end of the leaf brought to the centre; on the machine being put in motion, a pair of holes are made in the leaf at the same time, the proper length of wire is brought forward and seized by its middle, when it is cut off and bent into the shape of a staple, then conducted through the holes in the leaf where it is crooked, let lose and forced up to its place. The leaf is then shifted the space for the next staple, and the several movements again take place and are repeated until a row in width is compleat, when it is shifted the distance for

for the next row which is compleated in a similar manner, and so on until the card is finished.

In constructing this machine it is necessary to premise that the materials of which it is composed, and the mode by which the several movements are obtained, are not essential to the invention, but must be left to the judgment of the artist. As many cylinders of carding machines are about thirty inches wide, the following dimensions are suited to a machine for making cards of that size, or any that are less: a frame of iron or other metal or materials serving as the base of the machine, will be about seven feet long and twenty inches wide, on the ends of which are fixed two arms, about two feet high, inclining to the back front, about the angle of sixty degrees; the tops of them are curved back about two inches, and at the ends are holes to receive a bar, having at one end of it a wheel fixed with saw teeth which is furnished with clicks; and upon the same bar is fixed near each end (when it works in the arms) a small roller with pliable pieces, which connect them to the bar which hangs against and slides up and down upon the arms, but is prevented from moving sidewise. Near the tops of the arms is a rail to connect them together. Against this rail lies the top bar of a frame called the carriage, which is about three feet long, and is fastened to a bar the length of the base on which it slides. To this bar are fixed the racks or other contrivances to give it motion from side to side; within the carriage, and suspended from the hanging bar, is the stretching frame, which is about two inches shorter, and half the width of the carriage, having pieces at each corner to lie above and below the sides of the carriage to guide it in its motion up and down, as the top bar is moved by its wheel; and sidewise by the heart motion as it is called (to which it is kept up by a spring), which

gives the twill or other pattern to the card as it is shifted at the end of each row; at the middle of the base and close to the front edge is placed a stage, about a foot high and six inches wide, to support a plate to be hereafter described. At one end of the base is an upright of the same height with an arm reaching to the back front, upon which is jointed the lever with the moving click for shifting the wheel on the top bar, and in any convenient part is placed the standing click and the lever, which communicates the motion to the racks, if that mode of shifting the carriage be preferred. In the top of the stage and upright are holes for the main arbour to work in (to be turned by any kind of machinery), on which are fixed a number of single teeth or knobs to give motion to the several parts of the machine. The plate above-mentioned is about seven inches long and six inches wide, and is fixed upon the stage. The pricker having two points to pierce the leaf is about eight inches long, lying parallel with the plate, but beneath it, and reaching from the front of the arbour backwards to the stretching frame; it is jointed to an upright piece which works between centres on the base, and is forced back by one of the knobs on the arbour, and forward by a spring in its motion; the end is raised up by the inclined plane upon its underside sliding upon a bar, that when it had done its office it may fall out of the way of the other instruments. On one side of the plate is a contrivance to bring forward the wire for the staple, which may be done by levers, or pliers, or tongs, or rollers, the latter we think best, and shall describe their application: the rollers lie on the plate at right angles with the main arbour, and are about six inches long, a wheel on which gives them the necessary motion, by having teeth for about one quarter of its circumference only; these take into a small wheel on

one

one of the rollers which drive each other. The wire passing between them is conducted through holes before the fixed side of a pair of shears into the tongs, which are fixed to a thin piece about five inches long and two inches wide, sliding between two pieces in the middle of the plate; the back end of the tongs are the breadth of the staple and about half an inch thick, having a slit perpendicular to the plate, through which a thin piece called the crowner passes; there is also a slit parallel with the plate, which makes an opening for the wire. On the front of the tongs plate is fixed a piece like a gallows, the back leg of which covers the end of the tongs and is the moving half of them; against this piece, the crowner having a small notch in its end holds the wire as in a vice, when it is cut off by the moveable part of the shears which lie under the plate, and is jointed and moved as the pricker is, the back end being crooked upwards to correspond with the fixed part. The wire is thus held in the tongs until the staplers are forced back and give it the proper shape. The staplers are a pair of bars jointed upon a plate of the same width as the tongs plate, and sliding between the same side pieces, it has an opening in the middle to let it pass the crowner which works within it on the tongs plate. The back or working ends of the staplers are bent down to correspond with the tongs, and have grooves to let the wire lie in, these are closed by a spring between their front ends when their plate is forced backwards by its knob on the arbour, which bends the two sides of the wire into the shape of a staple, when they are drawn forwards by their plate spring, and the conductors which are two small levers fixed to a bar which is jointed to supports, fixed on the plate and moved up and down by their knob on the arbour; the back ends have small grooves in which the ends of the staple

staple lie, whilst the tongs are forced back by their knob on the arbour, and thus conduct them into the holes prepared for them. The part of the staple which should be crooked is now through the leaf, and upon the top of the anvil, against the edge of which the holes are pierced, is a bar about a foot long set up an end, and fixed to a support in the middle of the frame; the crookers are small bars about three inches long, fixed to a bar which is jointed to the anvil support, and to any convenient part at one end of the frame a little higher than the anvil, and parallel with the front of the case; this is moved up and down by a lever acted upon by its knob on the arbour; the crookers nearly touch the anvil, and have small holes to receive the ends of the staple, which by their motion are crooked to the desired figure, when the moving part of the tongs is lifted up by its lever, which is moved by its knob on the arbour, and gives liberty to the crowner to shoot back, and force up the staple to its proper place by means of its spring, and is then brought forward by its lever, acted upon by a knob on the arbour as the other levers are. The staple is now complete and in its place, and the carriage is shifted the distance for the next staple; the whole of these operations take place more than an hundred times in one minute.

To accommodate the machine to ribband cards or filliting, the stretching frame and hanging bar are removed, and a small pair of rollers are fitted to the carriage, which are moved by a band passing over a pulley on the top bar, and another on the axis of one of the rollers. The leather is put under a pulley fixed to the floor between the rollers, and over a pulley fixed above the machine, where a weight is suspended to it to keep it tight against the anvil, where it is pierced and stapled as the other cards are.

In witness whereof, &c.

Specification

Specification of the Patent granted to JOHN ISAAC HAWKINS, *of Bordenton, in the United States of America; now residing in Lisle-street, in the County of Middlesex; for new Machinery and Methods for Writing, Painting, Drawing, Ruling Lines and other Things, and for applying Parts of the aforesaid Machinery to other Purposes.*

Dated September 24, 1803.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Isaac Hawkins do hereby declare that my said invention for new machinery, and methods for writing, painting, drawing, ruling lines and other things, and for applying parts of the aforesaid machinery to other purposes, is described in manner following; that is to say: For writing, I affix two or more pens to a horizontal and perpendicular parallel ruler, so that no motion either up, down, sidewise, forward, or backward, can be made by one of the pens without moving the other or others in a similar manner; by which means I make as many letters or figures at the same time as there are pens, each letter resembling the other or others. By the same machine I rule as many lines at once, as I put pens to the parallel ruler. By the same machine also, I paint or draw two or more pieces at the same time, resembling each other, by putting to the ruler camel's-hair or other pencils instead of pens. For drawing with chalks or other substances, I put the substances into port crayons or cases, and affix them to the parallel ruler instead of pens. To draw likenesses of persons, I fix a tracer, upon a prin-

a principle hereafter to be described, to one or more parallel rulers, and also as many pens, pencils, or metal points, as I intend to multiply likenesses. This tracer is to be passed over the face, head, and such other parts of the body or other object as is wished to be represented in the drawing; and the pens, pencils, or points, will mark on paper or other thing placed against them, similar lines to that passed over by the tracer. I take likenesses in perspective, of various sizes at the same time, by a particular mode of placing the parallel ruler. I also take them of various sizes by fixing the tracer, pens, pencils, or points to a pantograph. I write, draw, or paint pieces of different sizes at one operation, by attaching pens, pencils, &c. to a double pantograph. I also distort writing for the purpose of secret correspondence, by putting the pen in a particular part of the pantograph or parallel ruler, which writing must be retraced by a similar instrument to make it legible. I take outlines of landscapes also with some of the aforesaid machinery. I also fix a marking point to a small pantograph, in a case which may be carried in the pocket to write memorandums, on a slip of paper stretched on two rollers in the said case, which slip of paper is moved along every time the line is written, so that a person can write memorandums, &c. in the dark, without any fear of writing two lines on one place. The essential principle in the construction of the tracer above-mentioned is, that it has a rotation on its axis, and that the tracing edge be in a line with that axis, so that turning the tracer round shall not alter the place of the tracing edge.

DESCRIP-

Description of the Drawings.

Fig. 1, Plate XII. is a geometrical side view of a machine and desk, made up in a portable form for writing two letters at once, A B C D E F G H I, the desk as it appears when open, the suspending frame C D E F is represented as broken, in order to shew the apparatus more distinctly. The dotted lines B L K C represent the desk when shut up. The writing apparatus in Fig. 1, and the whole of the Figs. 2 and 3, will be best explained together; the letters of reference are the same in each.

Fig. 2, is a view from above of the horizontal, and Fig. 3, a front view of the perpendicular parallel ruler, with their appendages; *z y* is the horizontal parallel ruler; the bar *z* has a pivot in each end, working in the studs *a a;* these studs are screwed down to the desk at *a.* The bar *y* has also a pivot in each end working in the studs *b b; c d* is the perpendicular parallel ruler; the pivots of the bar *d* work in the studs *e e,* which studs are screwed to the upper part of the suspending frame. The pivots of the bar *c* work in the studs *v v.* The studs *b b* and *v v* are made fast to the end of the bar U, through which bar go the arms *t t,* turning on their axis, and carrying the arms *w w.* The arms *t t* are made crooked, to make room for the fingers in holding the pen. Firm to the other end of the arm *t* is a socket *r s,* into which slides another socket *o p,* having a shoulder or stop at *o.* This inner socket is to contain a pen of quill or metal; the inner socket must slide into the outer from the end *r.* It is immaterial what distance the nib of the pen is out of the socket, provided all the pens are out of the sockets an equal length. Instead of one of the fixed studs *e,* in the suspending frame, I sometimes put a moveable one,

as represented by Fig. 4, where the pivot hole *a* is raised or lowered by the screw *b*, and moved forward or backward by the screw *c*. The two screws *d d*, are to fasten the whole to the suspending frame. The paper for writing on in the machine is held at its upper end by two plates of brass or other metal, the one plate let in and screwed to the lower part of the suspending frame at *q*, flush with the plane of the desk; into this plate are rivetted several studs with mortises in them, projecting through holes in the upper plate as shewn in Figs. 5 and 6; *n n* the studs, *c c* wedges joined to a rod *b*, put into all the mortises; the rod *b* is moved by a lever *d*; the paper *e e* being put between the plates, and the wedges forced into the mortises by the lever *d* is held tight. A metal ruler is laid on the paper near to the place of writing, to keep it from rising when the pens are lifted up; *f f* are spiral springs to support the weight of the apparatus; *k*, Fig. 1, is an ink-holder, of which there must be as many as there are pens, and placed at the same distances, so that every pen may dip in ink at the same time. From this construction it is evident that when one pen is lifted up or pressed down, the perpendicular parallel ruler will give the other the same motions. When one pen is moved forward or backward, the horizontal parallel ruler will move the other in the same manner. If one pen is moved sidewise, the other must be so likewise; because they are both fixed to one bar: and for the same reason, if one is inclined forwards or backwards, the other must move in like manner: and if one is inclined sidewise, the other will be so inclined, by means of the arms *w w*, and connecting rod *x*. The rods or bars of the parallel rulers, I prefer making of a light wood called lime-tree: though any other wood or even metal may answer the purpose. They will be about a quarter of an

an inch wide and one-eighth of an inch thick; the bar *a*, will be about three-quarters of an inch wide and half an inch thick; the other pieces in about the same proportion as they are drawn *. I make the rods *h h* of the parallel rulers double; because in that manner they are much stronger with the same weight of wood than if made single. Fig. 1, is drawn to a scale of about four inches to a foot; Figs. 2 and 3, about three inches to the foot; Fig. 6, six inches to the foot, and Figs. 4 and 5, of the full size; but specific measurements need not be given for this machine, as the dimensions should be according to the size of the paper. The parallel rulers should be large enough to suffer the pen to move freely over the whole surface of the paper, to be larger is not necessary. The pens should be a little farther a-part than the width of the paper. When more than two pens are used it is necessary to widen the machine, and add the pens to the bar *a*. The accuracy of the machine depends, first, on the desk being a perfect plane surface; secondly, on the rulers being perfectly parallel to themselves, to each other, and to the plane of the desk; thirdly, on the joints moving freely without any play; and fourthly, on the nibs of the pens being equidistant from and parallel to the rulers. All this being proved, and if it were possible to obtain pens of an equal degree of elasticity, the ink of one and the same quality, and an equal quantity in each pen, no difference whatever could be discerned between the writing.

To use this machine for painting or drawing, it will be best to fit it to an easel, the horizontal parallel ruler becoming the perpendicular, and *vice versa*. Such pencils are to be put into the sockets as are commonly used in painting or drawing. It will be well to have several sets of in-

* The drawings have been reduced to suit the size of our plate.

ner sockets, and as many pencils fixed in them as colours to be used, they will then be exchanged with but little loss of time.

Pallets are to be constructed with as many chambers in them as colours may be wanted; each chamber about one-twentieth of an inch deep and half an inch diameter; the chambers in one pallet corresponding with the chambers in the other or others.

Adjoining to each chamber a level surface is left in the pallet to touch the pencil on and equallize the colour; the corresponding chambers of the pallets being filled with the same colour, and the pallets fixed to the easel at the same distance apart as the pencils are: the aforesaid rules being observed with respect to the parallelism of all the parts to the plane of the canvas or pannel: and the length and elasticity of the pencils being similar as possible: two or more paintings or drawings may be made at once so nearly alike, as scarcely to be distinguished the one from the other. Chalks or other substances being put into the sockets, drawings may be multiplied with them.

Fig. 7, A, front view of a pen for ruling lines, to be put into the machine instead of the bar U in Figs. 1, 2, and 3, and its pens; B, end view of the same; *b*, a canal to contain ink, which will run through the slits *c c*, and mark lines on the paper over which it was drawn; *e f* is made of metal; *f g* of wood.

Fig. 8, is another plan of ruling pens. A, front view; B, end view. The construction of this is evident on inspection; *b b* are made of steel; *c c* of brass; and *e e* of wood. This is to be supplied with ink by dipping in a shallow trough, placed in some convenient situation. In both Figs. 7 and 8, *a* is the pivot hole for the horizontal, and of Fig. 1 for the perpendicular ruler.

Fig. 9.

Fig. 9. is a side view of a machine for writing two different sizes at once.

Fig. 10. is a view of the same from above.

Fig. 11. a perspective view of the same represented only in lines, in order that the principle on which the effect depends, may be more fully understood; the workman must clothe these lines with as much substance as is necessary to give strength to the machinery. The letters of reference answer for all three figures. This machine consists of two pantographs, whose planes, and the plane of the desk or table whereon the machine acts, coincide at their fulcra; and from thence diverge at an angle of about from five to ten degrees each plane from the other; *b b*, *c c*, separating bars which are united to the pantographs by universal joints, whose centres are in the centres of the joints of the pantographs, as well as in their planes. The universal joint I prefer, is that by which the mariners compass is kept on a level. From the separating bars *b b*, proceed arms *d d* carrying sockets for pens, which having been already described need not here be repeated; *e f*, are little wheels and springs to support the weight of the apparatus. The paper may be kept in its place in the same manner as above described. By this machine whatever is written by the pen *g*, will be copied by the pen *k*, on as much smaller scale as it is nearer the fulcrum. It is necessary to the proper action of this machine, that the nib of the pen be in a line with the axis of the separating bar to which it is attached. A pen fixed to a separating bar any where about *i i*, will so distort any thing that is written by the pen *g*, as to render it illegible. If this distorted writing be traced over by a pen or a point in a similar situation, in another machine of the same size, it will be written in the same hand as before. Writing done by a pen fixed to the bar *b* of

b of Fig. 16, will be distorted by another pen any where in either of the bars *e e*; pencils being put into the sockets of this machine, *viz.* Figs. 9, 10. and 11, and pallets as above described with chambers in proper proportions, being provided and filled with colours, two or more pieces may be painted at once of different sizes; chalks, &c. being fitted to the sockets, drawings in various sizes may be made with them.

Fig. 12. is a front and end view of a pocket machine to write memorandums on, *a*, a slip of paper, on two rollers *b* and *c*; passing over the flat bar *d*, which bar is covered with two or three thicknesses of paper, or a piece of thin leather; *e*, a pantograph; *f*, its fulcrum turning on the piece *g*, which moving on two pivots *h*, in the studs *i*, allow the pantograph liberty to move up and down; *k*, a crank, connected with an arm *l*, to the under side of which is a hook, catching in a ratchet wheel *o*, on the end of the roller *c*; *m* is a conical steel point to mark on the paper; *n*, a handle to write by, terminating in a round end just under the pantograph. Whatever is written with this handle on the ledge *p*, will not appear there, but in a reduced size on the paper; when one line is written and the handle brought back to begin another, press against the crank *k*, and it will pull the lever *l*, and by the ratchet wheel turn the roller, and thereby move the paper the distance of one line. A spring *q*, pulls back the lever and crank.

The rollers *b* and *c* have a slit in them to receive the end of the paper to keep it from slipping as represented by the section A. The whole of this figure is drawn full size.

Fig. 13. the tracer for the profile outline, *a* the tracing edge, which is thin like the edge of a knife, in a line with the axis *c*; the projection *d* at the back is to turn it round

round by; it is to be fitted by the shank *b* (which is a frustum of a cone) to the parallel ruler or pantograph, at right angles to the plane on which the parallel ruler or pantograph moves. E, an end view of the tracer; *a*, the tracing edge; the shank is about one inch, and the tracing edge five or six inches long.

Fig. 14. another form of the tracer, A, a ring with two projecting arms, to be fastened to the arm of the pantograph or parallel ruler by the screws *g g*. B is another ring which revolves on the ring A; C is a section through the diameter of the two rings, shewing the manner of their connection, *a* is the fixed ring, and *b* the moveable one; which is made in two parts screwing together at *c*. On one side of the moveable ring is a piece *d*, having a dove-tailed groove parallel to the axis of the ring, into which groove the tracer *e*, *f*, *g*, slides; the tracing edge *g*, being perpendicular to the plane of the parallel ruler or pantograph, and always in the axis of the ring, so that the revolution of the ring makes no alteration in the place of the tracing edge. The revolving ring is milled at the outer edges, in order that it may be easily turned. This ring will be made from one to three inches diameter, and from a quarter to half an inch thick; the sliding tracer about one foot long.

Fig. 15. another tracer somewhat similar to Fig. 13, but differing in this circumstance, that the tracing edge need not be more than three inches long and the shank of a cylindric form, in general from one to two feet in length; all these traces are to be made of metal.

Fig. 16. a parallel ruler to which is attached the tracer Fig. 14. the bar *c* is fixed to a perpendicular plane surface, on which the ruler moves. A point or points any where in the bar *b*, for instance at *d*, will mark a similar line on paper or any thing else pressed against it, as that passed

passed over by the edge of the tracer, of course if the tracer be passed over the outlines and features of the person *f*, they will be marked by the points *d d*, on the canvas or paper *h h*.

Fig. 17. is the same tracer attached to a pantograph whose fulcrum is at *b*, moving in a perpendicular plane. It is plain that any line passed over by the tracing edge will be imitated by the marking points *c c*, in as much smaller scale as they are nearer to the fulcrum.

Fig. 18. is a pantograph with the tracer, Fig. 13. to be used only in drawing the extreme profile outline. The arm *d* is made crooked, in order to prevent its pressing on the shoulder while tracing the breast, *c c*, the marking points which may be multiplied at pleasure, by adding bars parallel to those shewn in the drawing. In both Figs. 17 and 18, the marking points must be in a line *(f f)* passing from the tracing edge through the fulcrum *b*; and the joints *e e*, in a line with the tracing edge.

Fig. 19. is a view from above, shewing the way in which each of the tracers is used: *a*, the head of the person whose likeness is to be taken, resting against the piece *c*; *b* the shoulder. A, part of the arm of the pantograph Fig. 18, to which the tracer Fig. 13. is fitted; this arm moves in a perpendicular plane on the opposite side of the head of the person whose likeness is to be drawn, to where the operator stands. B, part of the arm of the pantograph Fig. 17, or ruler Fig. 16. which must move in a perpendicular plane, between the operator and person to be drawn, as near to the person as can be without touching him; the tracing edge is used on the extreme outline, and the point or termination of that edge on the other features, &c.; the sliding shank *d* is to be moved in or out to meet the inequalities of the features. By means of this tracer, applied as described, it is evident that the

likeness

likeness of a full face can be drawn. C, shews the mode of adapting the tracer Fig. 15. to the arm; the shank *f* slides in a collar *e*, and is used in the same manner as the last described.

Fig. 20. horizontal section of a box or case, *a a*, in which the pantograph works, and out of the side of which the arm containing the tracer projects at *b*; *d d*, frames to hold the paper or other thing against the conical steel marking points, *c c*. These frames are hung by hinges at the bottom of the box, they are made of two plates of brass hinged together, between which the paper is put. In the plate nearest to the point is an aperture large enough for the likeness to be marked through it on the paper; at the opposite end of the plates is a button to keep them tight together. The frame is pressed against the marking point by a spring *e*, which is turned aside when not wanted. This box is to be supported on a strong frame or easel, to which is also attached a piece for the head to rest against, as shewn in Fig. 17. The arm of the pantograph will in general be about two feet long, one inch and a half wide, and an inch thick; and the other parts bear the same proportion to the arm as in the drawing.

Fig. 21. is a perspective view of a machine for drawing outlines of persons at full length in perspective. A, a strong frame to be fastened to a wall, having projecting arms *b b*, between which the bar *c* turns on pivots; from this bar is suspended the parallel ruler *d*, hinged to the bar *f*, of the perspective parallel ruler *e*. The bar *g* is supported by pivots, and turns in the frame B, at the height and distance determined on for the point of sight of the picture; *x x*, are holes in the frame to vary the height; *h h*, are weights to counterbalance the weight of the apparatus on the opposite side of the bar *g*; *k*, the

canvas on which the picture is to be made, supported by the hook *m* in the bottom of the frame A, and held firm by the screw buttons *n n*, which slide up and down in the grooves *s s*, to suit the different heights of the picture. *i*, the person whose likeness is to be drawn standing on the step *l*, by the side of the canvas, and supported at the head and waist by the bars *p p*, which slide up and down in the grooves *r r*. On these bars are other projecting ones to keep the head, &c. steady sidewise; C, shews these bars more plainly, where *b b* support the sides and *a* the back. To prevent confusion in the perspective of this machine, the bars of the parallel rulers *d* and *e* are represented without thickness. D, therefore, represents the manner and about the size of the pieces of which I would make the parallel ruler *d*; and E, is a section of what the ruler *e* should be to give it strength without much weight. The tracer, Fig. 15, which is here used about two feet in length, is let half its diameter into the underside of the ruler *e*, at *u*; over which is screwed a cock *v*, Fig. E. The marking point *w*, which is shewn on a larger scale in Fig. 22, is also let half its diameter into the underside of the other ruler, and kept there by cocks *a a*; *b* is a block sliding in a dove-tailed groove *c*, and drawn by the springs *d d*, against the end of the shank *e*, of the marking point *w*, which is thereby pressed out against the canvas. When the point is not to touch the canvas, it is pushed in till the spring-catch *f* falls into the notch *g*; *h*, a small catch to hold back the catch *f*, when not in use.

Fig. 23. is a shank with a hole in the end *a*, to receive a piece of chalk, &c. *b*; its shank should be of the same size as the shank of *w*, so as to be put in its stead at pleasure.

Fig. 24,

Fig. 24. a geometrical view of the perspective parallel ruler; *g* the tracer, *b* the marking point, *h h* the hinges to attach it to the perpendicular ruler; *a a* the pivots which act in the frame B of Fig. 21; *c c*, holes to which the bar *g* may be removed to vary the distance of the point of sight; *e e*, additional bars and marking points to draw the figures of different sizes; *f f*, the pannels or canvas on which they are to be drawn, these are to be supported on easels. It will be necessary sometimes to put a board behind the canvas to keep it firm against the point. The accuracy of this instrument, *viz.* Fig. 21. will depend on the perpendicularity and planosity of the canvas; on the parallelism of the rulers, and of the bars *g*, &c. to the plane of the canvas; on the freedom but true sliding of the tracer and marker; and on the steadiness of the frames A B, and also the easels which support the canvas *f*. To use this machine take hold of the tracer *u*, and guide it over the parts to be marked, sliding it in and out to all the protuberances and concavities of the person. The size necessary for this machine may be judged from a comparison of it with the figure *i i*. The outlines of landscapes are taken by N° 16 and 17. A hole being fixed for the eye to look through, pass the edge of the tracer over the outline of the landscape, and it will be delineated by the marking points. To make black lead lines, rub a piece of thin paper with powdered black-lead, and place it over the canvas, pannel, or paper, mark on the back with the conical steel marking point of any of this machinery, and a well defined black-lead line will be transferred from the paper to the canvas, &c. Having to the best of my knowledge and belief, fully described and explained my machinery and methods for writing, painting, drawing, and ruling lines; I now

proceed to shew to what other purposes and things parts of the same may be applied.

Fig. 25. a parallel ruler applied to the purpose of turning a number of cranks in a row; *a a*, the spindles or shafts; *c c*, the cranks jointed to the bar *b*; the bar *d* being fixed, it is evident that if any one of the cranks be turned, the bar *b* will turn the rest.

Fig. 26. the parallel ruler applied to the sun and planet wheel, by which the shaft or spindle *e* will have double the velocity of the shaft or spindle *f*. Motion may be communicated in mill work in this way, from one shaft to another at a great distance, with much less weight of wood or metal than by connecting shafts and wheels.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM LOOSEMORE, *of the Parish of Saint Luke, Old Street, in the County of Middlesex, Factor; for a new Method of making and manufacturing certain Cloth for general Uses and Purposes.*

Dated December 20, 1799.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Loosemore do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is particularly described and ascertained as follows; that is to say: My said invention is to make cloth of different kinds, and fabrics fit for general uses and purposes, by employing in their fabrication fur or furs of different kinds, which have never hitherto been spun or woven into cloth or cloths; for this end,

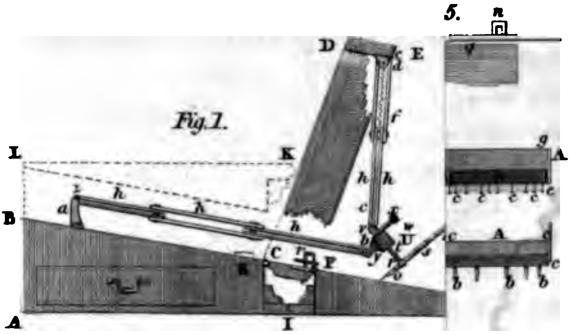


Fig. 1.

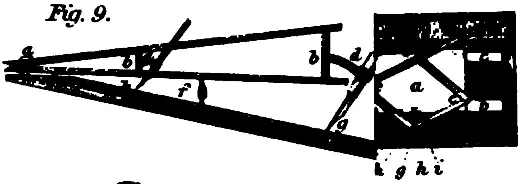


Fig. 9.

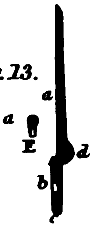


Fig. 13.

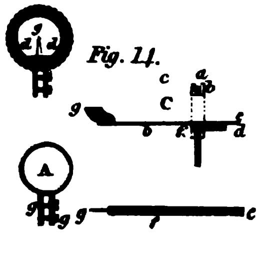


Fig. 11.

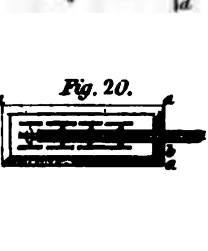


Fig. 19.

Fig. 20.

Fig. 25.

Fig. 26.

end, the yarn or thread employed in making or manufacturing cloths as aforesaid, is made or spun either from beaver, hares fur, or rabbits fur, singly, or from any one of them mixed, blended, or incorporated with any one, or with both of the other furs or materials aforesaid, according to the fineness or other quality intended to be given to the cloth, or according to the price at which it is intended to be sold. And cloths of other qualities and prices may, at the pleasure of the manufacturer, be produced by mixing or incorporating any one, or any two, or all three of the above-named materials; *viz.* Beaver, hares fur, or rabbits fur, in any proportions, at the pleasure of the manufacturer, with wool or with any other materials that have been hitherto, or that are now employed in making cloth for general uses and purposes; and such mixing or incorporating of one or more furs with wool or other materials as aforesaid, may be effected, either when the materials are in their raw state; that is to say, before they are carded, roved, spun, or made to pass through any of the usual operations; so that by such carding, roving, spinning, or other operation, they may be thoroughly blended. Or such mixing or incorporating of one or more kinds of fur with the other materials aforesaid, may be effected even after they have been separately or in various mixtures carded, roved, and spun, by disposing in the process of weaving threads or yarn spun from wool of any kind, hair of any kind, flax, hemp, cotton, silk, or any other material, hitherto employed, or at present made use of in weaving, knitting, making, or manufacturing cloths or fabrics of any kind. Or such mixing or incorporating in the process of weaving one or more kinds of fur with the other materials aforesaid, after they have been separately or in various mixtures carded, roved, and spun as aforesaid,

may

Specification of the Patent granted to* Archibald *Earl of* Dundonald; *for a Method or Methods of treating or preparing Hemp and Flax, and other Substitutes for Hemp and Flax, so as materially to aid the Operation of the Tools called Hackles, in the Division of the Fibre.

Dated June 28, 1803.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Archibald Earl of Dundonald do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, as follows; that is to say: My process for aiding the operation of the hackles in the division of the fibre of flax and hemp, and substitutes for flax and hemp, is to be done according to the methods hereafter to be described, being all upon the same principle, namely, that of removing from flax and hemp, and substitutes for flax and hemp, the bark and a considerable proportion of the mucilage or extractive matter before the hemp or flax has been dressed on the tools called hackles, or on or by any other tools or instruments capable of performing the same, or a similar division of the fibre. The hemp or flax intended to be operated on is to be wetted or steeped in water, or boiled for a greater or less length of time, as circumstances may require. It is then, in a wet or damp state, to be beaten, bruised, crushed, rolled, or acted on by beaters, stampers, rollers, or by any other mechanical means, so as to promote the solution and discharge of the mucilage or extractive matter, consequently to loosen the adhesion of the bark to the fibre. This process is to be done with or without a run of water on the hemp or flax while beating, crushing, or rolling:

the

other, in equal or in different proportions, and then composing both the warp and the woof or shoot, either wholly or partially, of the threads so twisted, or composing the warp only, or the woof only, either wholly or partially of such threads.

In the various methods already described and exemplified, beaver, hares fur, and rabbits fur, may be made into cloth either singly, or any two of them mixed with each other, or all three mixed and incorporated together: and in like manner in the same piece of cloth any one of them, or any two, or all three, may be mixed, blended, or incorporated with any one, or any two, three, or any greater number of the following articles, namely, wild cat, martin, musquash, squirrel, fox, otter, and all other furs, British, Spanish, Vigonia, Carmenia, and all other kinds of wool; camels, goats, and all other kinds of hair, mohair, hemp, flax, silk, cotton, worsted, and any other articles or materials that have been, are, or may be, employed in the manufacture of cloth; my said invention consisting in the employment of fur or furs in their fabrication, either alone, or mixed with other materials as aforesaid. The use or introduction of fur or furs as aforesaid, giving to the cloths composed either wholly or partially of such fur or furs a degree of flexibility, softness, lightness, warmth, and beauty, which cannot be attained in the usual methods of manufacture in which fur is not employed. And cloths made and manufactured by my new method may be dyed of any colour, in the usual manner, either by dying the materials when in the raw state, or by dying the yarn or thread, or by dying the pieces of cloth after they shall have been woven.

In witness whereof, &c.

Specification

Description of an Improvement on Gun-Locks to prevent Accidents from the unexpected Discharge of Fire-Arms.

By Mr. JOHN WEBB, *of Dorrington Street, London.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Twenty Guineas were voted by the Society to Mr. WEBB *for this Invention.*

THE following described invention may be applied to the gun-locks now in common use. It is contrived on such a principle, that when it is on full cock, and the trigger pulled in the common manner, it returns to the half-cock, unless, at the same time that the trigger is pulled, the pressure of the thumb is applied on a spring placed upon the butt or stock of the gun; in which case it gives fire in the usual manner.

The intent of this invention is to guard against the casualties which arise when fire-arms are left loaded, or the misfortunes which frequently happen from twigs of trees or bushes catching the trigger when sportsmen are passing through hedges.

REFERENCES TO PLATE XIII.

The letters of the several figures correspond together in the general description.

A, is the cock; B, the hammer; C, the main spring; D, the tumbler; E, the large sear; F, the small sear; G, the sear spring; H, the shank or arm of the large sear; I, the shank or arm of the small sear; K, the thumb-piece; L, the trigger; M, the lever of the thumb-piece; N, the spring which holds the thumb-piece up, when not pressed upon by the thumb.

Fig.

e 346.

Pl.XIII.Vol.IV. Secc

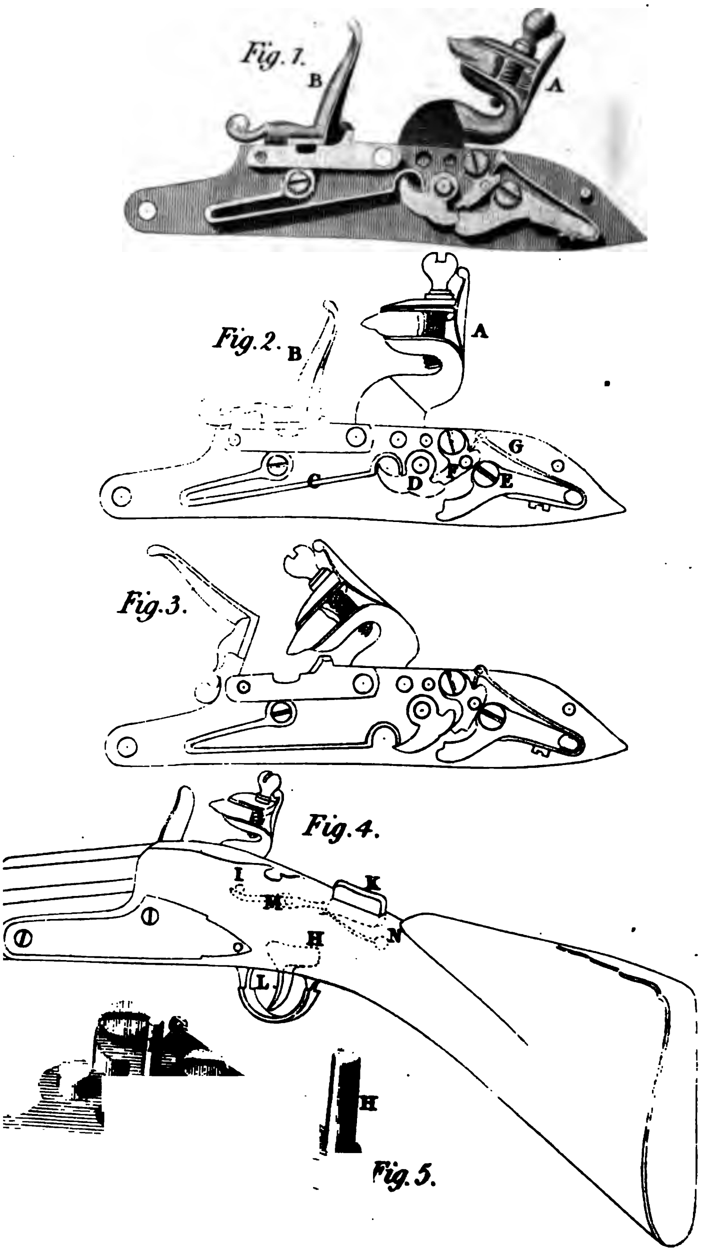


Fig. 1, is an interior view of the lock at full cock.

Fig. 2, the same lock at half cock.

Fig. 3, the lock when down.

Fig. 4, the lock fixed in the gun-stock, in order to show the thumb-piece K and the trigger L, with their mode of action. When the gun is held cocked in the usual manner, ready to fire, and the trigger L is pulled by the finger, the thumb, being pressed at the same time on the piece K, raises, by means of the lever M, moveable on a pin in its centre, the shank I of the small sear, and admits the cock to give fire as in the common way; whereas, if only the trigger L is pulled, the lock stops at the half-cock I; farther motion being prevented by a notch in the small sear. A spring N, screwed to the stock, returns the thumb-piece to its place, when the thumb is taken off.

Fig. 5, shews, on a larger scale, the construction of the tumbler, large and small sears, the sear-spring, and the manner in which they rise out of the bents of the tumbler.

Observations on the Dry Rot in Timber, and Means of curing or preventing it. By BENJAMIN JOHNSON, *Esq. of Ipswich; and* RICHARD RAMSDEN BRAMLEY, *Esq. of Leeds.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Society presented their Thanks to the above-named Gentlemen for these Communications.

THE mischief arising in buildings from that decay of the timber and wood-work, known in general by the name of the dry-rot, has been, and yet continues so

great as to demand every attention for its prevention. In the second volume of the first series of this work will be found some valuable facts, furnished by Robert Batson, Esq. of Limehouse, respecting the methods he took to prevent this evil, in one of his rooms greatly affected by it. The plan he adopted was to charr the ends of his timbers, to take away the infected earth to the depth of two feet, and to fill up that space with anchor-smith's ashes, or ashes from a foundery, before his flooring-boards were laid. On the 15th of May, 1794, which was upwards of six years after the flooring was laid, as above-mentioned, a minute examination of the boards, wainscot, and timbers, was made in the presence of a Committee of the Society for the Encouragement of Arts, &c. and they were all found entirely free from any appearance of the rot. To investigate the matter more fully, a farther inquiry has been made in June, 1803, and an answer received, that there has been yet no appearance of the dry-rot there; the Society, therefore, think it may be of consequence to notice the fact, and have inserted, in their last volume, some other papers with which they have been favoured upon the subject. They contain many hints deserving public attention, and which will doubtless tend to check the progress of this evil.

Mr. Johnson's Communication.

Some time between 1771 and 1773, I went, at the request of a friend, to the Chapel at the Lock-Hospital, through curiosity, to examine a pew there, that had frequently been repaired for damages by the dry rot.

After a close investigation, we found that it was the operation of a plant, whose leaf resembled that of the vine. Wherever it had touched, the effect of its poison-

ous

ous quality got through the wood to the paint, which I have seen a mere skin. I proposed to cover the floor with bricks, laid in mortar, which was accordingly done. I called twice since, the last time about seven years ago; and have reason to think that it had never appeared again.

The next opportunity of examining it carefully was at Mark-Hall, in Essex, the seat of Mr. Montague Burgoyne. In a parlour there were three pillars of about ten inches in diameter, the out-wood of which was between two and three inches thick. Two of them were eaten through in less than seven years, from the bases, about two feet upward, within the hollow, and were as rotten as if it had been the effect of a hundred years standing. Mr. Montague Burgoyne's gardener was a botanist: we found the plant where I directed him to search for it; and he said it was the *Boletus Lachrymans* *.

At another time, I saw it in a house at Whitehall, built by Sir John Vanbrugh, whose nephew then lived in it. The house is, I think, only two stories high; the plant had ascended to the upper story, committing devastation on the wainscot all the way. It will destroy half-inch deal wainscoting in a year.

I have had it twice in houses I inhabited, one in Suffolk, and the other in Gloucestershire. I bore with the first; in the other case, I undertook, and did stop it effectually.

* Some authors call it a parasitical plant; and it is sometimes to be found with the willow and sallow tribe, but this is not to the purpose. Till within a few months I have never been without some leaves of the plant. For many years they appear exhausted and dead, and soon crumble into dust; but I suspect that fresh wood attracts a fresh growth from the root.

The

The cause is from the floor being laid on the earth, which has been, where I have observed, of a gravelly or sandy loam. The moisture from a water-course at hand, or a north aspect, where the outer wall stands in a garden-bed, so that the rain percolates, are great encouragers: it requires moisture.

It never rises in the middle of the floor; because, if the seed were there, it could not germinate for want of air; but it is easy to suppose, that after the floor is shrunk, an air may be created between that, and the vacancy between the wainscot and outer wall, sufficient for the purposes of vegetation.

I saw an instance, last summer, in the house of a friend, a student in botany. He was surprised when I told him, it was a visit from a plant; but so it proved, and always is, and ever was so; nor does it originate from any other cause.

In my own case, I removed the original soil near the part affected, and supplied its place with sand. I then placed pieces of tile; on those I laid mortar, and tiles over them, pushing them under the wainscot, so that it had no communication with the joists or floor. Pillars, in like manner, should be kept from the earth.

In laying a floor upon the ground, I should take away the earth for a foot in breadth, and four inches in depth, all round the walls, and place the ends of the joists in mortar, covering them with tiles pressed under the floor and wainscot, quite to the outward wall. Iron or tin plates would do, but are not so cheap as mortar and tiles.

This plant has no adhesive powers but in contact with wood. If it could pass over brick or mortar, it might be seen to spring from the cellars, and infect half the houses in the kingdom.

In

In short, the wainscot is to be kept free from contact with the joists and floor; and I believe it cannot be better effected than I have described.

The leaves of the plant appearing exhausted and dead, is owing to their having imparted all their juices to the wood, which change it to a fungus, and not to a powder, like rottenness from length of time.

The *Boletus Lachrymans* is of the fungus tribe, and is one of the few that have leaves, as the misletoe, &c.

Nothing is more easy than to prevent the damage from the plant. Besides what I have before said, I am positive that a tile laid close along the walls round the room would prevent the growth of the plant, even without mortar; and perhaps it is only necessary where the walls are next to the air.

Charring the ends of the joists for a few inches, and charring the side of the wainscot at bottom next to the wall, would be sufficient; for the plant cannot adhere to any thing but wood, and that possessed of its natural juices to a certain degree; so that I question if old dry oak would receive it.

All the white soft woods, as beech, poplars, and deals, are for a long time ready to receive it. Repairing the damage with fresh wood, without removing the earth and plant, is only feeding the evil.

The plant is of the creeping kind, and cannot rise two inches; so that wood, in all cases, must be in contact with the earth to support it.

A fungus broader than the palm of one's hand, and an inch or more in thickness, is commonly seen at the bottom of an old post, on the surface of the earth; but it is not easy to discern whether the wood or the earth furnishes the matter; so true is the observation of Muller: —" Dans l'étude de la nature, on peut nous comparer à

de

de petits enfans qui commencent à ouvrir les yeux ; nous voulons parlér beaucoup, et nous ne faisons que bégayer."

The qualities of this plant are unknown to most English botanists, as appears from their publications; but they are known to the Germans, who have habitually used more wood in their buildings than we have.

I had lately a conversation with an old friend, who shewed me two parcels of rotten wood, from an oak barn floor, laid about sixteen years ago. After lying twelve years it shook upon the joists. On examination, it was found to be rotted in various parts, and the planks, two inches and a half in thickness, were nearly eaten through, though the outside was glossy, and without blemish. The joists and a large middle beam were laid at the ends, in brick and mortar, to create a firm level. No earth was near the wood ; and he thinks that no air could find a passage. The rottenness was partly an impalpable powder, of the colour of Spanish snuff, and other parts were black, as if burnt ; the rest was clearly a fungus.

This gentleman is a person of undoubted veracity ; but a nice and exact observation is necessary in such examinations. He thought nothing of any plant, and it is likely there was none of the Boletus ; so that my assertion, that it was always to be found, was rather too systematic.

I asked him if the timber was dry when laid down. He could not however say, that had been particularly adverted to. It had been sawed from a large oak, and was, as he thought, in all respects proper for a barn floor. As this seems not the operation of the Boletus, how did it happen ?

We know that the oak, when in vegetation, is subject to what I shall call an exudation of juices, which produces

[redacted]

duces the fungus, named the Agaric of the oak, with which the Druids of old played many tricks. The oak, then, if sawed into thick quantities, may emit these same juices, as the progressive course of nature to its entire decay.

We have all seen oaks of vast size and ancient record, with a great part of the outside whole, and all the inside gone; perhaps the work of a century. In all hollow trees fungus is discoverable. To use a law term, it is a *misnomer* to call it dry-rot; for the rotting principle is in moisture.

I had never seen the rot upon so large a scale as in timber, till lately. The prevention, then, of beams, rafters, large joists, and posts, put into the earth, from decay by the rot, is in charring only, which will dry up all the fungus juices of wood in large substance. Paint, or a bituminous preparation, may probably stop up the pores, and prevent the rot in slight work, where the treatment I before observed, with fire, might be incommodious, as in half-inch wainscot, &c.

The incorruptibility of charcoal is attested by undoubted historical facts, at the destruction of the famous temple at Ephesus. It was found to have been erected on piles that had been charred; and the charcoal in Herculaneum, after almost 2000 years, was entire and undiminished.

Mr. Bramley's Communication.

As the Society for the Encouragement of Arts, &c. have for some years offered a premium for the discovery of the cause occasioning the dry-rot in timber, of which, it seems, no satisfactory account has yet been received; should the following prove so, it will give the author much pleasure. To bring the matter to the test by ex-

periments would require the observation of a long period, and in selected situations.

Wood, used for the general purposes of man, is cut down at different periods; and although it may be felled at the proper season, or when most free from sap or moisture, it is not always to be effected.

Even admitting it to have been cut down in the most favourable situation, it still abounds with such an extra proportion of moisture, as to require a regular exposure to the air, prior to its being applied to use, if we wish to guard against that shrinking which always takes place, where this precaution has not been taken.

Although the fir kind contains less of this watery portion, yet it assuredly possesses a considerable share; and it is in this species, I apprehend, that the evil called the dry-rot most generally occurs, as from the facility of working the same, it is most generally applied in buildings.

But supposing it to be fir, or any other species; wood felled when abounding with any extra proportion of sap, and applied to use without the proper seasoning or exposure to a free current of air, until such extra moisture has had time to exhale, is most liable to the disease in question; and the cure, or principal prevention against it, would be the precaution of felling all wood only at the proper season, or when the sap is not in circulation. The next mode of prevention would be to use such wood only as has been for a considerable period exposed to the influence of a free current of air, or where convenience will admit, to that of air heated to a moderate degree; such air extracting with greater facility the inclosed moisture, and in a more certain ratio than the irregularity of our atmosphere will allow.

In

[redacted]

In all rapidly-improving countries, this evil is likely to be an increasing one, as the current demand for wood generally exceeds the supplies laid by in store, so as to be applied to use in regular succession, after being properly seasoned.

Another cause that affects all wood most materially, when not fully dried, is the application of paint, the nature of which prevents all exhalation, and confines the inclosed moisture, till it occasions a fermentation through the whole fibrous system of the wood, and brings on a premature state of decomposition, or the dry-rot.

A similar evil may be induced, in consequence of any newly-finished building having all the doors and windows shut up, and, that for some length of time, particularly in moist weather. The wood, even though unpainted, is thus frequently placed in an atmosphere more charged with vapour than its own internal contents, and is consequently in an imbibing instead of an exhaling state, and tending to decay. Wood placed in dampish situations, and the ends of timbers near to moist walls, suffer from similar causes.

What particularly attracted my observation to the circumstances was this, that both oak and fir posts were brought into this premature state of decay, from their having been painted prior to the due evaporation of their moisture; and then extending the observation, and tracing the history of other wood affected in a similar manner, I am convinced that the evil frequently thus originates, and its prevention would be in using timber, previously well dried and seasoned.

Since I communicated the preceding observations relative to the dry-rot in timber, I have been busily en-

gaged in draining 4 to 5000 acres of ground, and farther ideas on the subject of the dry-rot have recurred to me from the work I have been engaged in, which may probably be worthy of attention.

Where houses are troubled with damp walls, near to the earth's surface, it is generally, if not universally, occasioned by the percolation of water from the higher adjoining ground, which, thus intercepted in its current, attempts to follow the general hydrostatic law, of elevating itself, by the syphon line, to a height equal to that from whence it has its origin. Thus, in houses differently situated, we see the damp arising, to varying degrees of height, on the walls; and those are probably all corresponding to the height at which the moisture circulates in the adjoining ground. At its first entrance to the building, and whilst the moisture is in small quantity, the excavated part of the foundation wall may absorb, and gradually quit such proportion; but the excess, as is generally the case in moist weather, exceeding that power, the foundation stones are then saturated in a more rapid proportion than the adjoining rarified internal atmosphere can evaporate: the watery particles then creep up, in degrees proportionate to the ascent from which they originally descended, excepting when prevented, or driven off by the superior heat of the adjoining rooms, when, in addition to the disagreeable damp they cause, they frequently occasion considerable damage to pictures, furniture, &c. Drains laid out athwart the ascending ground, with a very slight descent or fall, and made of the depth of one yard for each yard of ascent, and from the foundation until equal to the height that such damp ever rises, would, there is little doubt, completely secure the house and furniture from the inconveniences hitherto sustained, and would generally prove an effectual prevention

vention to most cases of the dry-rot, where it originates in extreme moisture. I am of opinion that the fungus which pervades decaying wood is not the first cause, but an attendant on the peculiar state to which such wood has been reduced by prior causes. The disseminated seeds finding a proper bed, or *nidus*, like to the mushroom, toad-stool, &c. fix there their abode, and pervade the whole substance, thus accelerating the general law of Providence, which tends to make all matter reproductive.

Cellars, or such other places, should be drained in the manner I have above-mentioned, by taking off the percolating water, prior to its gaining admission to, or contact with, the walls; and it is probable that, in most cases, a single drain will have complete effect; it would assuredly do so, if it was not for the variation of the earth's internal strata, which are not easily discernible. If attention to this rule was paid prior to the building any new streets in towns, it would prove essentially useful.

The Society have been informed, that mortar made of lime from burnt chalk is much more destructive to timber than stone lime, or that burnt from lime-stone. Chalk lime attracts moisture; and communicating it to any timber which it touches, occasions its decay.

Sea sand is also prejudicial, if made into mortar, from a similar quality of attracting moisture from the atmosphere: this may in some degree be corrected by washing the sand well in fresh water, where good sand cannot be procured.

Good mortar, where any is required to be in contact with timber, may be made from a mixture of stone lime fresh burnt, and river sand, to which a very small quantity of common brown, or yellow iron ochre, should be added, and well incorporated therewith.

Comparative Experiments in Agriculture. By Mr. JOHN WRIGHT, *of Pickworth, in the County of Rutland.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal was presented to Mr. WRIGHT *for this Communication.*

THESE comparative experiments in agriculture appear to have been managed with great judgement, and contain valuable hints on the proper time for sowing corn, and the quantity of seed necessary to be sown; they also point out the advantages of the drill husbandry over the broad-cast.

Experiment I.

June 15, 1802. Began to mow tares for soiling cattle.
July 27, ——. Finished, being just six weeks.

Stock kept and Quantity consumed.

Nine cart-horses kept wholly upon them, without corn or any other food. They had been used to a good allowance of corn previous to soiling, and were in high condition, though wrought every day; they worked the same on the tares every day (Sundays excepted), kept their flesh and spirits, and were rather improved at the end of the six weeks. I kept likewise during the same time forty hogs (swine). The hogs had every day one bushel of offal barley, or bad beans, value 2*s.* 6*d.*

Improvement made.

	£.	s.	d.
The hogs improved, one with another, as far as I could judge, 2*s. per* week . . .	24	0	0

The

				£.	s.	d.
Brought forward				24	0	0
The horses kept upon this excellent food I value at 5 *s.* *per* head *per* week				13	10	0
				37	10	0
Mowing and bringing home tares	1	10	0			
Corn for hogs, 2 *s.* 6 *d.* *per* day	5	5	0	6	15	0
Profit . . .				30	15	0

Clear profit 30 *l.* 15 *s.* for five acres of tares, including seed and once ploughing, which were but a small crop. I have had a considerable quantity more upon the ground. However, 6 *l.* 3 *s.* *per* acre for a fallow crop, as this evidently was, is no despicable profit. The land must have been naked fallow had it not been for this crop; and from its being off so early, the land got a complete fallow of three excellent ploughings and harrowings, and was in good time sowed with wheat, which now looks very well, and the land in my opinion is not at all injured.

Experiment II.

Jan. 25, 1802.—This day made an experiment to ascertain what culmiferous crop will pay the farmer best after potatoes. As there have frequently been a diversity of opinions on this point, the soil, which was a poor gravel, worth about ten shillings *per* acre, had borne the following crops:

1797. Naked fallow without manure.

1798. Barley with clover.

1799. Clover pastured, manured with eight tons of farmyard dung, well rotted, once ploughed, and sowed with wheat.

1800. Wheat.

1801.

1801. Potatoes, drilled at three feet, well horse-hoed; but without manure.

1802, Jan. 25. Measured off three exact half acres, and sowed.

No. 1. Sowed with 3 bushels of oats; reaped Aug. 18.

— 2. Sowed with 2 bushels of barley; reaped Aug. 23.

— 3. Sowed with 1 bushel and a half of wheat; reaped September 4.

PRODUCE.

	£.	s.	d.
To 21 bushels of oats, at 2 *s.* 6 *d.*	2	12	6
Seed and expenses	1	12	0
Profit on oats	1	0	6
To 12 bushels of barley, at 3 *s.*	1	16	0
Seed and expenses	2	4	0
Loss on barley	0	8	0
To 9 bushels of wheat, at 7 *s.*	3	3	0
Seed and expenses	2	1	3
Profit on wheat	1	1	9

I have here charged the prices for seed, and the price of the produce, as they then actually sold, which is no just criterion, and makes much against the barley, the seed of which was bought at 44 *s.* and the produce sold at 24 *s.* a price at which the farmer certainly cannot afford it. A given price should therefore be fixed upon: suppose, for instance, wheat 60 *s.* barley 36 *s.* and oats 24 *s.* the experiment will then stand as follows:

Oats

	£.	s.	d.
Oats 21 bushels, at 3 *s.*	3	3	0
Expenses	1	14	6
Profit on oats	1	8	6
Barley 12 bushels, at 4 *s.* 6 *d.*	2	14	0
Expenses	1	14	6
Profit on barley	0	19	6
Wheat 9 bushels, at 7 *s.* 6 *d.*	3	7	6
Expenses	1	16	9
Profit on wheat	1	10	9

The barley still not nearly so profitable as either the oats or wheat, though this is quite a barley soil. Another circumstance against the wheat is, its being sowed so late. On the other hand, some may imagine that the early sowing of the oats and barley was unfavourable to them; but that is not my opinion, as it is a dry soil, and worked well at the time. However, they were all as good crops as generally grow upon such soils, which have received no better management. I have charged but one year's rent for the land, and nothing for manure, which though it had none for this crop, yet something ought to be charged.

Experiment III.

Upon the same day, and on the same soil, I sowed, for comparison, two exact half acres with wheat, one broad-cast with one bushel and a half, the other drilled with Mr. Cooke's machine, at eighteen inches asunder,

 with

with two pecks and a half. The drilled received three hand-hoeings, with a common turnip-hoe, on the 24th of April, 8th of May, and in June. The difference in colour was very great, the drilled being of a deep green, as luxuriant as if growing upon the richest soil.

PRODUCE.

	Bush.	Pecks.				£.	s.	d.
Drilled . .	11	0	at 56 *s.* *per* qr. . .			3	18	9
Broad-cast .	9	0	at ditto			3	3	0
						0	15	9
To saving of seed in the drilled at 4 *l.* 4 *s.* the price given				9	2			
				4	6			
Neat saving						0	4	8¾
Superiority in favour of drilling .						1	0	5¾

Superiority *per* acre in favour of drilling 2 *l.* 1 *s.* 11½ *d.* and the ground was certainly left in superior condition. Some may imagine I have undervalued the hoeing; but when I inform them it was hoed by the day, at 2 *s.* *per* man, they will be well aware the men would not work too hard.

Experiment IV.

The same day, and upon the same soil, I sowed, for comparison, two exact half acres with barley; one broad-cast with two bushels, the other drilled with three pecks at eighteen inches asunder. Broad-cast ripe three days first, the drilled the same hoeings, and on the same days as the wheat. The luxuriancy of the drilled made strangers think it was wheat, nor were they convinced until it came into ear. I never saw such a flag upon barley, nor straw so strong.

PRO-

[redacted]

PRODUCE.

	Bush.	Pecks.		£.	s.	d.
Drilled . .	21	2	at 3 *s.* *per* bush. . .	3	4	6
Broad-cast .	12	0	at ditto	1	16	0
				1	8	6
Saved in the drilled, exclusive of hoeing and drilling				0	2	4½
Superiority of drilling only half an acre . .				1	10	10½

The difference is astonishing. Authors talk of drilled barley being unequally ripe, which was not the case with this. The barley had the largest body I ever saw, which certainly was one reason why it measured so well.

Experiment V.

On the same soil an experiment was made to ascertain what month is most proper to sow barley in. Four exact half acres were measured, and sowed in the following manner with two bushels each:

No. 1.

Sowed 25th Jan. The ground worked well. Ripe Aug. 23.

No. 2.

Sowed 24th Feb. Did not work quite so well. Ripe Aug. 26.

No. 3.

Sowed 17th March. Worked very well. Ripe Aug. 28.

No. 4.

Sowed 19th April. Worked well. Ripe Sept. 14.

PRODUCE.

	Bushels.	Pecks.	Quarts.
No. 1. January . .	12	0	0
— 2. February . .	11	2	0
— 3. March . .	14	1	3
— 4. April . . .	11	0	2

 This

This experiment proves that March is the best, and April the worst month to sow barley in. I assign as a reason for February being deficient, the ground working rather the worst. However, it worked as well as it may generally be expected to do in that month: a proof that judging by the eye is erroneous. The crops both of January and February looked better than those of March.

Experiment VI.

On the same soil an experiment was made to ascertain the most proper quantity of seed-barley *per* acre; the usual quantity here is four bushels. If you ask a farmer the reason why he sows four bushels, he replies, his great-grandfather and all his ancestors did the same, and of course it must be right. Now if his great-grandfather and all his ancestors made the same answer, it is evident that no improvement has taken place since the days of Adam; and that, whether the soil be rich or barren, sowed early or late, the same quantity is uniformly applied. Five exact acres were measured and sowed with the following quantities of seed. They were all sowed the same day, March 17, 1802, except the drilled, which was sowed January 25.

		Bushels.	Pecks.
No. 1,	sowed with -	2	2
— 2,	——— -	2	0
— 3,	——— -	1	2
— 4,	——— -	1	0
— 5,	drilled at 18 inches	0	3

PRODUCE.

	B.	P.	Q.		B.	P.	Q.
No. 1, or 5 Bushels *per* Acre	12	3	0	or *per* Ac.	25	2	0
— 2, or 4 ———	13	0	0	———	26	0	0
— 3, or 3 ———	11	2	0	———	23	0	0
— 4, or 2 ———	12	0	3	———	24	0	6
— 5, or 1½ ———	21	2	0	———	43	0	0

This

This experiment shews the quantity of seed, from two bushels to five, not to be of so much consequence as might be supposed. I did not expect they would have come so near to each other; and I am unable to assign a reason why three bushels should be less than any other quantity. The superiority in favour of drilling is astonishing, and likewise cheaper than any of the others, except the two bushels.

Account of the Season 1802, *after the Crops were sowed.*

February. — More dry, and less frosty than usual.

March. — Bright, cold, cutting weather; but little downfall of any kind.

April. — Moderate showers, and one very wet day. My barley sowed in January looked very ill in this month.

May. — Exceedingly dry. Farmers in high situations wanted rain very much. Several very severe frosts for this advanced period.

June. — Moderate rains at the beginning. The latter part dry and warm.

July. — Cold, and exceedingly wet throughout; so much so that almost all the hay was spoiled.

August. — After the first week it cleared up; and the finest harvest almost ever remembered succeeded.

Certificates accompanied the above paper from the Rev. R. Lucas, Rector of Casterton, Pickworth; and George Sesson, of Essendine, in the county of Rutland, confirming the statement made therein.

Description of an Improvement on the Siphon invented by Mr. JOHN NORTON, *of Rolls Buildings, Fetter-lane.*

With an Engraving.

Communicated by the Author, in a Letter to the Editors.

GENTLEMEN,

I HAVE invented a very simple improvement on the siphon, by means of which it may be easily filled without the necessity of employing an air-pump, as in the common way. I apprehend, therefore, that in many cases it may be of considerable utility, as it will remedy many difficulties attending the siphon in present use. It may be made either of copper or iron; but in situations where it may be required to convey water any considerable distance, I would recommend wooden pipes to be used in consequence of their cheapness. These pipes may be connected, according to circumstances, at angles, by means of cast-iron elbows, so as to form a zig-zag down the side of a rock or hill.

Large pieces of water on lands standing on high situations, or springs in mountains or in mines, may be easily drained by this siphon.

I am, &c.

JOHN NORTON.

REFERENCES to Fig. 1, Plate XIV.

a to *b* is the common well-known siphon; *c*, is a clack-box, fixed at the end of the siphon *b*, to prevent the water from running out during the filling at the aperture *d*; *e*, *c*, *e*, are plugs, made to fit the apertures *a*, *d*, and *f* which is a conical pipe, for giving vent to the air during the filling of the siphon.

In

In order to fill the siphon, the plug *e* must be inserted in the end *a*, sufficiently tight that the weight of the water in filling may not force it out; the plugs at the apertures *d* and *f* must then be taken out, and water enough poured in at *d* to completely fill the siphon; after which replace plugs *d* and *f*. If the plug at *a* be then drawn out, the water will commence running, and cause the valve at the end *b* to open. The siphon will then act as long as there may be water at the end *b* to be carried over.

On the double Refraction of Rock-Crystal, and on another dioptric Property of that Mineral Substance.

By P. Torelli di Narci.

From the Journal des Mines.

Double refraction, that singular property of rock-crystal and several other minerals, has long engaged the attention of mineralogists and natural philosophers, without their having made any other use of it than employing it as a distinguishing character. M. Hauy * says, " It would be difficult to find a more prominent characteristic than that which is derived from double refraction, since it belongs to the very essence of the minerals in which it exists "

M. Rochon is the first who employed this property of rock crystal in measuring small angles; on the 26th January, and 9th of April 1777, he read Memoirs to the Academy of Sciences, on the application he made of it, and the exact results that he obtained. This discovery must be of the greatest utility if the instrument which he

* In his Treatise on Mineralogy, vol. I. p. 254.

invented

invented could be afforded at a moderate price, within the reach of all those who might find an advantage in using it for measuring distances.

With a view to attain this end, I undertook a series of experiments on the cutting of rock-crystal, and on the double refraction of that substance, founded on those made by Beccaria and Rochon. With rock crystal alone I have made *double refractive mediums*, (as Rochon denominates them) cut cylindrically, and composed of two or three prisms of that substance which are perfectly achromatic, and produce a very strong double refraction. I have executed one, the angle of whose double refraction is one degree eight minutes, and I am convinced that a still greater may be obtained.

I shall not here state the way in which I cut my different prisms of rock-crystal, to obtain the maximum of double refraction, as I have still a few experiments to finish in order to ascertain that particular. Among those which I cut for my experiments, is one which produces effects so singular, that I think I ought not to omit a description of them.

This prism, the section of which is an isosceles triangle, has one obtuse angle of above 100 degrees. When looked at through the two sides which form the obtuse angle, and in a direction parallel to the opposite side; the object appears neither out of its place nor perceptibly coloured, but only turned in such a manner, that what is on the right appears to the left, and *vice versa*. If, for example, you look at the letter L cut out and applied to one of the sides, the horizontal line of that letter, instead of appearing to the right under the vertical one, appears situated to the left; if you continue to look at the letter, and turn the prism as if it was traversed by an axis, parallel to the direction in which you are viewing the

the letter, the image of it turns round at the same time as the prism, but it moves with twice the rapidity, so that while the prism makes one turn, the image of the letter makes two. With this prism I have made other experiments, but too long to be detailed here: I shall reserve them for a memoir, in which I shall explain the methods I employed to ascertain the directions that ought to be followed for cutting rock-crystal, so as to produce the maximum of its double refraction, and thus enable the artist to construct, without hesitation, the instrument invented by Rochon, for measuring all kinds of distances with very great precision. I am at present engaged in determining its application to the survey of mines, and shall describe the manner of using it to measure the deepest wells and the longest galleries.

I shall conclude this note with a brief statement of some experiments that I made with the isosceles prism of rock-crystal above described. By applying it to a simple *camera obscura*, you restore to their proper position objects which are represented reversed when the prism is not employed. By adapting it to astronomical telescopes, it likewise rectifies objects which, when seen through the two convex glasses composing them, appear reversed.

This prism likewise affords the means of shortening telescopes constructed for viewing terrestrial objects; for by employing it with one convex eye-glass only, and the object-glass (whether simple or achromatic) instead of three, four, or five eye-glasses, you will see, in their proper situation, objects which without its interposition would appear reversed. Thus, two, three, or even four eye-glasses may be dispensed with, and the telescope might be shortened of great part of the length which these eye-glasses occupy. The clearness of the instrument would

would thus be augmented, the prism causing a very small loss on account of the extreme transparency of the substance of which it is formed. Nor would it be inferior in point of accuracy, for the prism being very near the eye, the defects that might proceed from any inequality in the formation of its two surfaces would be imperceptible.

In making use of this instrument, it must be recollected that at the same time that it turns objects the bottom upwards, it likewise turns the right to the left, so that what appears in the telescope on the right is actually on the left; for example, if you look at a man who is walking from the right to the left, he appears through this telescope to be going from the left to the right, but in his natural situation; while on the contrary, if you view him through the same telescope, without the prism of rock-crystal, leaving only the eye-glass which reverses the object, you will then see the man not only move in a contrary direction to that in which he is actually going, but he will likewise appear reversed; the ordinary effect of telescopes which have only a single convex eye-glass.

Experience alone can prove whether this method of shortening terrestrial telescopes is capable of being rendered as useful as it appears curious; and, whether it will be possible to make them at a price sufficiently moderate to support the competition with those of the ordinary kind; without which, this instrument will rank only in that class of discoveries which are more curious than useful.

Method

Method of constructing or altering the Flues of Chimneys, to prevent them, in certain Cases, from smoking.

By M. Piault.

With an Engraving.

From the Bibliotheque Physico-Economique.

It very frequently happens that chimneys smoke on account of the wind, which prevents the escape of the smoke, and drives it back; and, indeed, when the wind is very high there are few chimneys which are not more or less susceptible of its ill effects. Sometimes the action of the wind is immediate; at others it acts only by reflection; and the latter effect is usually produced by its being situated near a wall.

But in either of these cases the construction, described below, will in general, if not always, be found to preserve the chimney from smoking. It is particularly advantageous, as it is applicable to every kind of chimney, and is attended with very little expense.

The alteration it produces is not intended to skreen the chimney completely from the action of the wind, but to dispose it in such a manner that, whatever wind may blow, the smoke may always find a vent by which it may escape.

These observations on the action of the wind are equally applicable to that of the sun; it is well known that the smoke is prevented from ascending through the chimney when the air round the top of it has been rarefied by the rays of the sun.

By the present method of construction, part of the chimney (at least in these climates, where the shadows are never entirely lost) is always preserved from the action of the sun.

Description of Fig. 2, Plate XIV.

a, a partition which divides the chimney in a transverse direction, penetrating about a foot below, and rising the same height above it.

b, *b*, two portions of the walls, each of which rise from the longitudinal side of the chimney; they join at right angles, but in contrary directions at the extremity of the transverse partition; so that these two portions of the wall, joined to the partition, and of the same height as the latter, are of this form _|¯

c, *c*, apertures of the chimney.

From this description it is easy to conceive, that on whatever side the wind or the sun strikes upon the chimney, one of the apertures, *c c*, is preserved from their action, and the smoke escapes without difficulty by that aperture.

It would perhaps be an improvement upon this method of construction, to form the partition with two sides, and to give the portions of the chimney which join to it such an elevation that the wind may be reflected in a contrary direction to that of the aperture of the chimney.

In common chimneys the wind is reflected exactly in the inside of this aperture.

This apparatus has already been constructed for a great number of chimneys, and has always been found to answer the purpose for which it was intended.

Description

Description of Woulf's Apparatus, with moveable conducting Tubes. By M. SCHMIDT, *Professor at Prague.*

With an Engraving.

From SCHERER'S JOURNAL DER CHEMIE.

THE letters C D E F, Plate XIV. Fig. 3. represent a bottle, with a wide mouth, into which a conical funnel A B enters half way. The funnel is hermetically luted in the neck of the bottle, and through it descends the tube G H, which is a little curved at its lower end H, for the purpose of making the gas ascend by the side of the funnel. The conducting tube L K I, with a curved branch, is likewise put through the funnel, and drawn up again, so as to bring the branch nearer the top of the bottle. The same disposition is observed with regard to the second bottle, and all the succeeding ones. Then fill them with the proper liquids till the aperture of the funnel B is immersed a few inches. The gas which, conducted by the tube G H, escapes at H, is condensed above M N, and the pressure which it produces is transmitted by the conducting tube L K I, till it finds a vent at H, and passes into the second bottle, after causing the liquid in the first to descend below the aperture H of the tube G H; in consequence of which the gas is subjected to a pressure equal to the weight of a column of liquid, whose diameter is equal to the diameter of the bottle, and of a height equal to the elevation of the liquid in the funnel, which elevation is a consequence of its diminution in the bottle. This pressure, as it is well known, promotes, in an infinite degree, the dissolving power of the liquid, or the absorption of the gas. With this disposition of the apparatus the bottles may be turned, raised, or depressed, without apprehension of deranging the operation, and in particular

particular the trouble of luting a great number of joinings is avoided.

To empty the liquid out of the bottles the syphon C A D, Fig. 4, is employed, having a globule A B adjusted to the top of the curvature. Plunge the end C into the liquid, close the aperture D with the finger, and draw up the air through A. By the rarefaction of the air the liquid ascends and falls into the branch B D, and the syphon is entirely filled. Then by closing A, and opening D, the liquid may be drawn off at pleasure.

Extract from an Essay on the Preparation of Prussiate of Potash, perfectly free from Iron, and on the Inalterability of Prussic Acid in a red Heat, by J. B. Richter. *With Experiments on the Nature of Combinations of Prussic Acid with salifiable Bases, by* J. B. Van Mons.

From the Journal de Chimie.

THE experiments of the author, which were all conducted upon a large scale, gave the following results:

1. Prussic acid is formed during incandescence in carbonised blood; it is therefore an error to be afraid of increasing the temperature, or not to keep up for a sufficient length of time the red incandescence of the matter.

2. The affinity of Prussic acid with potash is stronger when dry and at a high temperature, than with water and at a low temperature, a remarkable peculiarity that distinguishes Prussic acid from all other compound vegetable and animal acids, which are separated from fixed alkalis by a red heat, let their union with those bases be

ever

ever so strong, at a temperature not exceeding 80° of Reaumur.

Hence it follows:

a. That in the preparation of pure prussiate of potash, all operations in which humidity is employed should be dispensed with as much as possible.

b. That it is not possible to obtain the immediate saturation of potash with Prussic acid, but to effect this saturation, the excess of alkali should be taken up by acetic acid mixed with alkohol; the combination, thus formed with the potash, remains dissolved in the latter liquid.

c. That the most certain and the shortest method of separating the iron from common or ferruginous prussiate of potash, is to subject that salt to a red fusion; and that after the mixture of the alkaline solution, (which needs not to be entirely free from carbonic acid), with the Prussian blue, the ley should be evaporated to dryness.

By this method of proceeding, the quantity of Prussic acid that is lost is scarcely perceptible, and the evaporation likewise procures this advantage, that the ferruginous parts, which form a pulp, as long as the matter remains moist, may afterwards be separated by the filtre.

3. When pure prussiate of potash appears to be decomposed of itself, that effect is occasioned either by the carbonic acid contained in the atmosphere, or by the disunion of the principles of the Prussic acid, or by both those causes. This is proved by the exhalation of Prussic acid which is attended with a pungent smell like that of bitter almonds and of ammoniacal gas; and both these are frequently produced at the same time.

4. The prussiate of common potash, with whatever care it may have been prepared, and however pure it may be, always forms a triple salt of Prussic acid, potash, and

and iron, or a solution of prussiate of iron * in prussiate of potash.

5. There is only one neutral metallic combination, and in particular of iron, with Prussic acid, which can exist at every temperature from that of the atmosphere to ignition; a neutral combination between that acid and potash. The more free this combination is from iron, the more the affinity between the principles of the salt when dissolved is relaxed. It has likewise been observed that the size of the crystals and their durability diminish in the same proportion.

6. All metallic precipitates formed by prussiate of common potash contain more or less iron.

7. It is not yet clearly demonstrated that phosphoric acid is not a co-principle of Prussic acid; as the contrary is not positively proved by the synthetical experiments with ammoniac and charcoal.

8. Oxyd of iron is more strongly attracted by carbon than by prussiate of potash; which explains the cause why the small quantity of that metal contained in blood unites with the remaining carbon rather than with that prussiate.

The observation that in order to dissolve iron in Prussic acid, a higher degree of oxydation is required than for its dissolution in other acids, as sulphuric acid, &c. is very just. But experiments have demonstrated that this superior degree of oxydation differs very little from that which the bare possibility of dissolving iron in other acids requires, and the greater the degree of oxydation, the more speedy is the formation of the blue. The same phenomenon is observed in the formation of other metallic

* Prussiate of iron, and in general almost all insoluble metallic salts, are thermoxidulated or oxidulated combinations, or salts with excess of thermoxyd or metallic oxyd.

tallic prussiates; thus, a nitrous solution of mercury, prepared by ebullition, and corrosive muriate of the same metal, are much more completely precipitated by prussiate of potash than the other mercurial salts in which the metal is but slightly oxydated. Thus, too, the precipitation of pure prussiate of the same kind is effected much better, by adding to the mixture a small quantity of nitric acid.

The author concludes by announcing that M. Bohm has discovered prussic acid in the vegetable kingdom. He was induced by the similarity of smell to seek that acid in bitter almonds. With this view, he distilled those almonds, reduced to a pulp with water, and collected the produce in a recipient containing a small quantity of caustic potash. In this manner he obtained a liquid, which, with sulphate of iron, furnished a precipitate that was converted by muriatic acid into a very dark blue powder. He likewise digested the ley of caustic alkali with bitter almonds, and obtained from the liquid the same precipitate. M. Richter saw specimens of these two prussiates; but M. Günther, of Breslaw, repeated the experiments without obtaining the same result.

Experiments on the Nature of Combinations of Prussic Acid with salifiable Bases.

The nature of combinations of prussic acid with salifiable bases has not yet been examined by any chemist. Some operations on Prussian blue undertaken to ascertain its utility for manufacturing purposes, furnished me with some hints on the subject which I think worth making public.

Experiment I. Into a glass retort, I put neutral prussiate of potash, recently prepared, and placed the retort

in a sand-bath, so as to communicate with a mercurial pneumatic apparatus. A moderate fire was made and kept up till the disengagement of gas ceased. For some time prussic acid gas was disengaged; but, it afterwards ceased though the fire was considerably increased even to a degree approaching incandescence.

When the apparatus had grown sufficiently cold, a quantity of hot water capable of dissolving the residue was poured to it, filtered and set to crystallize. A prussiate of common potash was obtained, having a strong alkaline taste, turning natural blue vegetable colours green, and which lost neither its taste nor its power of reacting upon blue colours, by repeated crystallizations.

Experiment II. The same experiment was repeated with a saturated solution of neutral prussiate of potash; the result was absolutely the same. Prussic acid was disengaged upon the very first impression of the heat, and the residue yielded prussiate possessing alkaline properties.

Experiment III. I put into the retort the salts remaining from the two preceding experiments, and increased the heat to incandescence. No undecomposed prussic acid was disengaged, but I obtained water, ammoniac, carbonate of ammoniac, carbonated hydrogen gas, azote and carbonic acid gas.

The conclusions naturally formed from these results are, that prussic acid may exist in potash in two different states of combination, or at two degrees of saturation, the neutral and alkaline saturation.

That in the first saturation the neutralizing portion of the prussic acid is but slightly combined with the alkali, or rather with the alkaline prussiate, since that acid separates from it at a degree of heat much lower than that of boiling water, and far more easily when moist than dry.

I like-

I likewise ascertained that both the solution of neutral prussiate, and the same prussiate in a concrete state, gradually lose the neutralizing portion of their acid by exposure to the air.

That in the second or alkaline saturation, the acid adheres so strongly to the alkali that it cannot be separated without being decomposed.

Experiment IV. I operated upon common alkaline prussiate of potash in a retort, and with the mercurial apparatus. No gaseous substance was disengaged before the heat was so augmented, that the retort was in a state of incandescence. At that degree of heat I obtained the same products as in Experiment III. but the proportion of carbonic acid gas was much more considerable.

Experiment V. An alkaline solution of common potash was brought into contact with carbonic acid gas. In 24 hours the absorption was not observed to be more considerable than with pure water.

Experiment VI. The same experiment was repeated but with alkaline prussiate, recently prepared by the deneutralization of saturated prussiate. An absorption of carbonic acid was observed at least three times greater than in the preceding experiment.

Experiment VII. Into a solution of alkaline prussiate of common potash, somewhat concentrated, I poured about the quantity of acid necessary to saturate the alkaline part. A strong effervescence took place, occasioned by the disengagement of a gas, which being collected and examined was found to be carbonic acid gas.

Experiment VIII. The same experiment was repeated with prussiate rendered alkaline, by the expulsion of the neutralizing acid. When the salt was recently prepared, and particularly when no part of it had been decomposed by the fire, no effervescence was observed.

From these experiments it follows, that potash may be combined into a triple salt with prussic and carbonic acids, and form a carbonato-prussiate, which, however, is not entirely neutral, for in that state it turns green the vegetable blue colour.

The carbonato-prussiate exposed even to a powerful heat, suffers no carbonic or prussic acid to escape, whence it results that those two acids mutually fix each other in a neutral or almost neutral state, or that the excess of the alkali in one salt retains the acid of the other in the same manner as if both were alkaline.

Experiment IX. I saturated the alkaline portion of prussiate of potash with sulphuric, nitric or muriatic acid. Upon slightly heating the liquor, it emitted a very strong smell of bitter almonds, and the same smell was perceived even without being heated. Upon evaporating the liquid, for the purpose of producing crystallization, I obtained, separately, the salt formed by the acid employed and potash, and deneutralized or alkaline prussiate.

This experiment proves that potash does not form a triple salt with prussic acid, and one of the three abovementioned acids, and that after the saturation of the alkaline portion, the prussiate exists in the state of a neutral salt, which is decomposed into an alkaline prussiate by the heat of the evaporation; as is demonstrated by the strong smell of bitter almonds that is emitted.

Experiment X. I poured upon Prussian blue, cold, a solution of alkaline carbonate of potash, and agitated the mixture for a few moments. The greatest part of the Prussian blue dissolved. I filtered the liquor which was of a brown colour, somewhat tinged with green, and decomposed it with an acid. A great quantity of the finest Prussian blue was precipitated.

Experi-

Experiment XI. The same experiment was repeated with alkaline carbonate of soda. The result was perfectly similar.

According to these experiments the potash and the soda, taking away the prussic acid from the iron, combine with that acid, forming alkaline prussiates, and the excess of alkali of those salts holds in solution great part of the iron precipitated. A portion of the acid remains united to that salt, composing carbonato-prussiate of potash and iron, and the other portion combines with the undissolved blue, which it converts into oxydulated prussiate of iron; and thus the alkaline carbonate is here decomposed.

When caustic alkali is employed in these experiments it dissolves less iron, which proves that the carbonic acid concurs in the formation of the quadruple salt, carbonato-prussiate of potash and iron. By employing neutral carbonate of alkali, the neutralizing acid is dissipated.

When the mixture of alkali and Prussian blue is heated, the quantity of iron dissolved is considerably greater.

Experiment XII. By treating Prussian blue, either cold or hot, with liquid ammoniac, then filtering and decomposing by an acid, no precipitate is obtained.

Hence it follows, that ammoniac does not form a triple salt with prussic acid and iron.

The prussiate of ammoniac which is not precipitated of a blue colour by acids, affords chemists a very pure re-agent for iron.

Experiment XIII. I diluted Prussian blue with a solution of prussiate of barytes, and precipitated with sulphuric acid. The Prussian blue dissolved entirely; but being suffered to stand a few hours in a gentle heat, it was again precipitated, and a disengagement of prussic acid gas likewise took place.

This

This experiment appears to prove that prussiate of iron, neutral or saturated with an acid, is soluble in water, and that the common Prussian blue is an oxydulous prussiate, or a prussiate with excess of basis of metallic oxyd. But this combination is so slightly attached to the neutralizing acid, that it separates from it spontaneously. I have not, however, succeeded in dissolving Prussian blue immediately in the water charged with prussic gas; a first essay induces me to think that the green prussiate, which had heretofore been considered as a mixture of yellow oxyd, and of blue oxydulated prussiate is a carbonated prussiate super-oxydulated, or at the second degree of metallic supersaturation. It even appeared to me that the last portions of prussic acid are the more difficult to be separated either by alkalis or fire, in proportion to the degree of that supersaturation.

Acids separate from superoxydulated prussiate only the superoxydulating portion of iron. With Prussian blue, however, they form a combination which alkalis are unable to destroy.

Alkaline earths do not appear to contract an alkalino-terrene union with prussic acid. Alkalino-terrene prussiates are, therefore, totally decomposable by fire without distinction of acid. Alkaline earths may, nevertheless, form a triple combination with prussic acid and iron, when the quantity of acid necessary for their saturation is wanting, and in these combinations with iron, they more strongly retain their acid.

In the formation of a triple prussiated salt with alkali, a separation of the prussic acid from the iron frequently takes place, if the oxydulated portion of that metal is not sufficient to complete the saturation of the ferruginous prussiate.

Carbonic

Carbonic acid expels the neutralizing acid from neutral prussiate of potash, and taking its place, forms carbonato-prussiate.

From all these facts we find that prussic acid very nearly resembles carbonic acid, both in its gaseous form and in the property of combining with excess of alkaline and metallic bases, and of separating spontaneously from those bases, when it is saturated or neutralized by them.

Prussic acid is the least destructible of all acids which have a compound radical.

Observations on the Causes of the Imperfection of Furnaces for Evaporation, and on a new Method of constructing them, so as to burn, with Economy, every Species of Fuel. By M. Curaudau.

With an Engraving.

From the Annales de Chimie.

Notwithstanding the attempts that have hitherto been made to economize the fuel necessary for manufactures, no method has yet been discovered to employ it without any loss; a much greater quantity of wood is invariably consumed than is required to keep up the ebullition in furnaces for evaporation, or to raise the temperature in those intended for other purposes. It is obvious that this superfluous consumption must, in large establishments, be extremely injurious to the proprietors, and that it may, at some future period, contribute to produce a scarcity of fuel. Upon this two-fold account it is, therefore, of importance to seek to prevent a dearth of which future generations might justly accuse us as the authors, if we do not seriously direct our attention towards discovering the means of introducing greater economy

body will be in a state favourable to their oxygenation, and all the caloric emitted and resulting from the re-action of the oxygen on the combustible will be disengaged and employed without loss.

Under these circumstances the action of the oxygen is considerably augmented by its successive renewal; for the higher the temperature of a furnace the more easily the external air penetrates into it. When, therefore, the incandescence is raised to a high degree, it is necessary, and very advantageous, to slacken the current of the air, not by closing the aperture of the furnace, as is usually done, but by diminishing, or even closing the upper aperture of the chimney; by these means the caloric is concentrated in the interior of the furnace, and it is prevented from escaping any other way than through the liquid in the boiler.

This observation on the manner of stopping the current of air at the top of the chimney may likewise be applied to the furnaces of foundries; and in those cases where it is necessary to keep up the heat of a metal without its being exposed to the oxygenating action of a current of incandescent air.

General Observations on the Construction of Furnaces.

That part of the fire-place which is to be exposed to the greatest heat ought to be made of very refractory bricks. The best mortar to be employed in every case where it is wished to procure a bad conductor of caloric, is a mixture of equal parts in bulk of tan and argil. The tan prevents the mortar from cracking, and produces an unctuosity, which by desiccation gives it very great tenacity.

Furnaces in general may likewise be constructed of this kind of mortar, and upon the same principles as those for evaporation which I am about to describe.

Furnaces

Furnaces intended to endure a violent degree of heat ought to be inclosed externally with a very thick wall constructed of mortar prepared with tan, for by these means very little of the caloric is lost. Furnaces in general ought likewise to be constructed in such a manner that the top of the chimney may be closed at pleasure, in order to abate the effects of the combustion, and concentrate the caloric in the interior of the furnace when that is necessary. It is particularly at the moment when the temperature is very elevated that the issue of the current of air should be regulated, in order to prevent it from traversing the interior of the furnace with too much rapidity, when in certain cases it is detrimental to the success of the operation.

By combining all these conditions in furnaces in general we may depend upon saving nearly one-fourth of the fuel, and to effect combustion without any appearance of smoke. I insist particularly on this observation, because it is invariably and physically demonstrated that a combustible body is never completely burned till it ceases entirely to emit any smoke.

Description of a Furnace for Evaporation, in which the Temperature may be raised at Pleasure.

(See Fig. 5, Plate XIV.)

The aperture of the vault A should be four decimetres wide and 3½ decimetres in height for ordinary furnaces. B, is the part of the vault where the combustion is to be effected. This vault ought to be at least two metres in length. C, represents a boiler 1½ metre in depth, and the same in diameter, fixed in a furnace of brick. The bottom of the boiler ought not at most to be above one decimetre from the bottom of the furnace. In the construction of the furnace attention ought to be paid to make the bricks approach gradually round the furnace,

and to reduce the space till the distance does not exceed three centimetres. This must be continued till within one decimetre of the edge of the boiler, where the bricks may be made to touch it. D, is an aperture, two decimetres wide and one in height, communicating with E. But from the angle *a* this conductor of the heat should be one metre in length and one decimetre in width, and this proportion should be continued to the aperture E.

F, is a second boiler, intended to be heated by the superabundant heat from the first; if it were required, several others might be added. G, is an aperture of the same proportions as D. Care must be taken at the angle *b* to make the aperture of the chimney five decimetres in length and two in width, and to continue that proportion for about two-thirds of the height. The aperture must then be diminished so as not to be less than one decimetre in width and three in length at the upper aperture. That part of the chimney ought to be constructed so as to be capable of being closed at pleasure when it is necessary.

On the Preparation of pure Gallic Acid, and on the Order of Affinity of that Acid with Iron. By J. B. Richter.

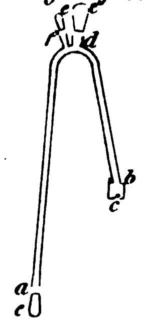
From the Journal de Chimie.

Pure gallic acid does not, according to the general opinion, separate the iron from sulphuric and other acids, and when a decomposition of that kind takes place, it is invariably owing to the effect of a double affinity.

The opinion of those who imagine that gallic acid forms a black mixture only with oxyd of iron, at a high degree of oxydation, is absolutely destitute of foundation; for that acid no sooner comes in contact with oxyd of iron, separated from any other acid, than a black gallate is formed.

The

Fig.1. Page 366



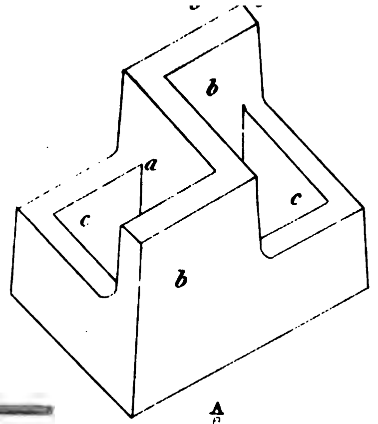
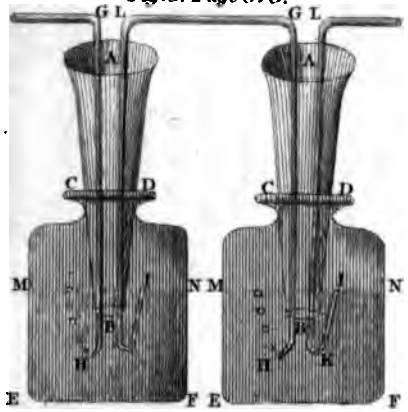


Fig.3. Page 373.



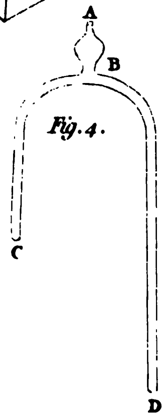
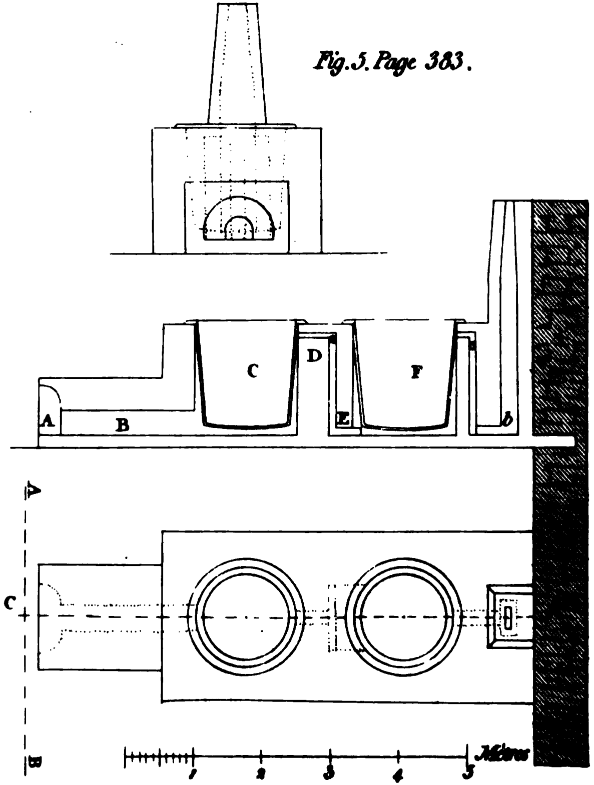


Fig.4.

Fig.5. Page 383.



The black colour acquired, in time, by a mixture of pure gallic acid and a clear neutral martial solution, affords no proof in support of this erroneous opinion; for the access of the air, at the same time that it superoxydates the metal, separates it from the acid in which it is dissolved, and enables the gallic acid to unite with it and form a gallate. The same effect may be produced by adding to a clear solution of iron a small quantity of the oxyd of the same metal recently precipitated, or by merely mixing a small proportion of that oxyd with a solution of gallic acid.

When, in a clear neutral martial solution, a black precipitate is formed by the addition of an infusion of gall-nuts, or any other vegetable astringent matter, the iron is separated from it by virtue of the double attraction of the gallic acid for the metal, and of the tanin for the dissolvent acid of the iron. By adding an excess of any acid whatever, the formation of a black precipitate may be prevented, and that already formed disappears. The tanin is soluble even in vegetable acids.

When a perfectly clear solution of black sulphate of iron becomes more or less black at the moment of its mixture with the gallic acid, that acid cannot be pure.

In extracting the gallic acid, care should be taken not to suffer the matter to come in contact with metals, especially iron; as the slightest communication of a solution of gallic acid with the latter is sufficient to prevent the formation of the white crystals of that acid. As filtering paper is rarely free from iron, it is not advisable to strain the gallic solution through paper of that kind; even the use of charcoal, for the purpose of purifying it, should be avoided. The presence of iron in a solution of gallic acid is manifested during the evaporation by spots of a deep brown, approaching to a violet black, that appear round the edge of the liquid in those parts where the

the crystals are about to be deposited ; and the same colour is communicated, more or less, to the crystals, which are very small.

As the tanin is soluble in gallic acid, consequently that acid, prepared by spontaneous evaporation in the air, according to Scheele's method, must hold a portion of that principle in solution. It has, therefore, been remarked that repeated crystallizations cannot render it entirely colourless, and that the martial salts are always precipitated from it of a black colour.

As gallic acid is easily soluble in alkohol, and tanin does not dissolve at all in that liquid, by this medium the gallic acid may be deprived of all the tanin which it contains; but for this purpose alkohol perfectly pure, or entirely free from water, should not be employed, as the smallest portion of the latter liquid, were it only the quantity of one-half per cent. not belonging to the elementary combination, or forming a component part of the alkohol, would be sufficient to prevent the entire separation of the gallic acid from the tanin, which this portion of water would dissolve.

As the gallic acid is separated from the tanin by alkohol, consequently its affinity with that liquid is greater than with tanin. That affinity, however, is not so great as to separate, in this manner, all the gallic acid of the tanin ; for the residue after that acid has been extracted by alkohol still precipitates black martial salts.

The method of separating gallic acid by muriate of tin and sulphuretted hydrogen is too troublesome and uncertain, and that of precipitating the tanin by animal gelatine is impracticable. The method of extracting that acid by means of alkohol should, therefore, be adopted as the easiest, the most certain, and the most productive of acid.

Process

Process for extracting the Salt with a calcareous Basis contained in yellow Quinquina.

Communicated by M. DESCHAMPS *to* M. FOURCROY.

From the ANNALES DE CHIMIE.

TAKE of yellow quinquina, pounded and passed through a hair sieve, 12 pounds *. Put it into a large spouted pitcher, and pour upon it 50 quarts of clear cold water. Let it steep 24 hours, taking care to stir it frequently during the day; pour it off the next morning, straining through a very fine sieve of goats' hair the liquor that must have been left to settle all night; put the first and succeeding infusions into vessels, and place them in a cool situation.

After well draining the pulp, pour upon it 30 quarts of fresh cold water. Let it stand 24 hours, stirring the matter as before: pour off the liquor, and to the pulp add 20 quarts of cold water; making in the whole 100 quarts.

After steeping 12 hours, pour off the liquor, drain the pulp by means of pressure, mix all the infusions together, filtre and set them to evaporate in a large basin either of silver or tinned copper. The heat employed for this purpose must be considerably lower than the degree of ebullition;

* The quinquina which I have hitherto employed in preference for extracting the salt is the yellow, as it yields a greater quantity, and its purification is attended with less difficulty than the red and grey, which I have also tried. The quantity that it may be made to produce is, according to an accurate calculation, one ounce three-pennyweights for each pound of yellow quinquina that is employed. The weight of the quinquina upon which I operate, is not less than twelve pounds. That quantity is attended with less loss than in operating with a smaller dose, and the crystals are much larger and more distinct.

ebullition; when the liquor is reduced nearly one-half, pour it into a vessel, in which it must be left till quite cold; filtre and wash several times in cold water the filtres charged with the deposit that is formed.

Pour these washings to the filtered liquor, the evaporation of which must be continued in a smaller vessel, till it is reduced to six or seven quarts. Set it to cool in this state, filtre it again; wash the resino-mucilaginous deposit as before, till the last portions give a very small deposit, with the addition of carbonate of potash.

Continue these evaporations, filtrations, and washings, till, by means of a gentle heat, you have brought the liquor to about half the consistence of a syrup. Pour it off into a stone pan *, which place in a cool situation, where it must be left to stand a fortnight.

At the expiration of that time, drain off, by sufficiently inclining the pan, the condensed liquor covering the crystals that are formed; wash the latter with cold water, gently rubbing them with a small soft brush or a feather, to separate the thick extract by which they are covered.

Having washed them, separate the crystals, taking up with them as little as possible of the resino-extractive matter, upon which they are frequently fixed in this first crystallization †; pound the salt, dissolve it by means of several

* For these crystallizations I prefer flat pans to those that are of a conical form.

† If care be taken to filtre the liquor several times during its concentration, having previously let it stand to grow cold, it will be found to be purified of the resino-gummy portion, to such a degree, that with the first crystallization the saline mass, though of a red colour, will be almost entirely cleared even to its base of that matter which I have been most desirous to separate from it.

The

several triturations in a sufficient quantity of cold water; filtre these solutions together with the liquor produced by washing the crystals, set them to evaporate, and reduce them to a degree proper for crystallization *.

This first purification furnishes crystals almost colourless, and containing a much less quantity of substances foreign to the salt.

If the salt is required to possess the highest degree of whiteness, the operator must proceed to a second purification in the following manner.

After washing and separating the crystals, dissolve them cold as above; filtre them, wash the deposit, and reduce the liquor by a slow evaporation to a suitable quantity.

The salt thus obtained will be very fine and perfectly pure; the crystals are formed of flakes, truncated at the extremity, and laid obliquely over each other. I propose to denominate them *calcareous quinquinate.*

I have frequently obtained a different disposition in the crystallized mass, which struck me the more as it does not very frequently occur. It consists of groups perfectly circular, and composed of flakes that diverge in a regular

The small portion of this salt, which I have the pleasure of transmitting you, is the produce of a first and only crystallization conducted in the manner above described. When the infusion is reduced to the quantity of six or seven quarts, I take care, in the course of the next evaporation, to filtre it cold, at three several times. By adopting this method, a very small quantity of foreign matters adheres to the saline crust, and the supernatant extractive matter is separated with the greatest facility.

* The farther I advance in the purification of my salt, the less I thicken the liquor; the degree of concentration should be proportionate to the quantity of extractive, or resino-mucilaginous matter which it contains.

This degree is rather difficult to be ascertained.

 man-

manner; they are, in a manner, isolated and form a summit, that rises considerably above the plain surface of the other crystals. This variation in the assemblages takes place only in the first crystallizations; I have never yet observed it in those produced by the purified salt.

It may justly be imagined that the process above described is not sufficient for extracting from the quinquina all the salt that it is capable of furnishing. The thick liquor drawn off from above the first crystallization, and which is put aside, contains a considerable quantity; to obtain which, it is necessary to separate as much as possible from the extractive matter, the two other immediate substances contained in quinquina, which principally tend to prevent the separation of the saline substance; I mean the resin and the mucilage, which are extracted severally or together.

To this end, when I wished to ascertain in the most accurate manner the quantity of salt contained in yellow quinquina, at the same time confining myself to the agency of water only, I treated this compound extractive matter cold, in the way already mentioned for the purification of the first produce. By multiplying the washings, filtrations, and evaporations, I succeeded in separating the extractive matter of quinquina which, when thus treated, retains scarcely any of the mucilaginous part.

When the saline liquor, purified in this manner, ceased to yield any more crystals, I mixed it with that drawn off from the salt, when brought to the highest degree of purity. This mixture furnished a considerable quantity, and the liquor which I, at last, threw away, still had an appearance sufficiently saline to justify me for allowing in my recapitulation a certain quantity as contained by it. The examination of it afforded only similar products

to

to those which I obtained by the decomposition of the crystallized salt. The matter which I precipitated from it was absolutely of the same nature, but more high-coloured, on account of the resino-extractive matter which it retained.

The method here pointed out, and the very complicated manipulation I have described, are attended with considerable trouble, and require much time and expence, which might doubtless be spared, by treating the bark in a different manner. I have frequently thought that by making fewer infusions, washings, &c. though I should obtain a smaller quantity of salt, yet as the nature of the produce would not be altered, the advantage derived from it would be greater.

Having operated in the first instance for the purpose of analysis, I proceeded with the most rigorous accuracy, that as little as possible of the salt might escape me, and I have since accustomed myself to that method of manipulation.

However, I have reason to believe that by means of alkohol the operation might be greatly abridged; that fluid, having no action on the calcareous salt of quinquina, might be employed in two ways to take up the resin which forms the greatest obstacle in the extraction of that saline substance, either by submitting the quinquina in its natural state to the alkohol, previous to the process of aqueous infusion, or by exposing to its action the extractive matter resulting from the mixture of the first infusions.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Society of Sciences, &c. of Bordeaux.

THE Society of Sciences, Belles Lettres, and Arts of Bordeaux, in the year 9 (1801), decreed as the subject of a prize the following questions:

What is the most simple and easy method of discovering and distinguishing the staves of a cask, liable to communicate a musty taste to wine?

What is the best process for taking from wine the musty taste which it has contracted in the casks?

None of the memoirs on this subject having fulfilled the conditions of the programme, the same question was proposed for the year 13 (1804), and the prize reserved to be adjudged in the public meeting of May next.

Society of Agriculture of Paris.

The distribution of the prizes took place as usual.

Manures in general were the subject of the prize offered by this Society for the present year, but, none of the memoirs transmitted having attained the aim of the society, the prize was continued another year, and increased to 3000 francs. The society had likewise resolved to decree, in the year 1804, a prize of the value of 2000 francs to the author of the memoir who should present the most enlightened ideas and best experiments on the construction and use of the best plough. While the reporter was reading the programme, a letter was received from the minister of the interior, the substance of which was, that 2000 francs were not a sufficient reward for the person who should give the greatest degree of

perfection

perfection to the implement in question: he therefore proposed to raise the prize to 6000 francs, and to pay it himself. If the aim of the competition be obtained, the money will be well bestowed.

New Thrashing Mill.

Mr. Christopher Perkins, of Stockton, Durham, has invented a thrashing-mill upon an improved plan, capable of thrashing 20 bushels of oats in one hour, and 12 sheaves of wheat in less than four minutes. It is employed for thrashing only, but works in a very superior manner. Twelve feet in the barn gives sufficient length for the machine as well as the management of it, but as it stands close to the wall, it does not project above four feet. The horse-wheel is very complete, upon a perfectly new principle, and entirely put together with screw-bolts. Though one horse is capable of working the mill, a provision is always made for yoking two. The horse-track is 20 feet in diameter within the posts or pillars, and consequently the centre of the perpendicular shaft of the wheel is not less than ten feet from the wall of the barn.

Engraving on Stones.

In consequence of the particular value attached to engraved stones, it has often been wished that some matter easy to be worked, and at the same time uniting beauty to solidity, could be discovered. With this view a trial was lately made in France of steatites, which has perfectly succeeded. In consequence of its softness, this matter can be cut and turned with great facility, and being composed of very fine parts, the greatest accuracy may be observed in the operation. The stone is worked in its natural state. It is then put into a crucible covered with a tile, and the tile being luted with clay, the whole, surrounded with charcoal, is put into a furnace. It is exposed

exposed to a slow fire, and kept at a white heat for two or three hours; after which it is taken from the fire and suffered to cool gradually. The stone, by these means, becomes very hard, strikes fire with steel, and wears the best files.

Method of preserving Turnips from the Fly.

Mr. G. Lindley, of Catton, near Norfolk, has succeeded in saving a crop of Swedish turnips from the fly, by sowing radishes with the seed. Last May he sowed above two acres of this turnip, with about four pounds of radish *per* acre. Upon the first appearance of the plants, they were attacked by such numbers of the common turnip-fly, that the loss of the crop was thought inevitable. To give it all the chance possible, however, he employed a person to draw a drag-rake over the ground every other day, once on a place, for four or five days, the stirring of the ground contributing not only to the growth of the turnip, but likewise disturbing the flies, so that it is some hours before they resume their depredations. The radish was always found to be the particular object of their prey, and in many places of two or three feet square not one plant was left; while in others they were much too numerous for the quantity of seed allowed. In those places where the radishes were missed, the seed was swept clean off; where they were numerous, the turnips were all safe and vigorous.

The expense of this method is light, as a man can easily drag over an acre in less than two hours, and radish does not exceed one shilling *per* pound. In some seasons it is much lower; the long salmon radish ought to be preferred, being much more mild and a quicker grower.

Experiments

Experiments on Wool.

Messrs. Huzard and Tessier have been for some time trying, at Rambouillet, the result of suffering the wool to grow for several years successively on a few sheep. Last season some of these sheep were shorn for the first time these three years. The average weight of their fleeces was 12 kilogrammes, one of them weighed 15; and this wool, which was above 3 decimetres in length, fetched 6 francs 68 centimes *per* kilogramme. Hence it appears that the wool of one fleece was equal in length to three others together, and that it produced a larger sum. With this kind of wool M. Delarue has manufactured very beautiful casimirs, for which he obtained a medal at the exposition of the productions of national industry.

Sixty-three rams of the old importation were this year sold; they fetched upon an average 320 francs, the average price the preceding year was 412 francs. Forty-three ewes of the same flock were sold: the average price was 336 francs, while that of the year 1802 was only 236. This difference in favour of the ewes, and against the rams, proves two points equally remarkable and important: 1, that the farmers who purchase stock at the sales at Rambouillet to cross the common breed, begin to have a sufficient stock of rams; 2, that they endeavour to propagate the pure breed, and wish by the acquisition of ewes to relieve themselves from the necessity of again having recourse to the national establishment for a supply of rams.

Method of preserving Pulse from Weevils.

M. Fabroni, in his Elementary Instructions in Agriculture, lately published, gives a method of preserving pulse from the depredations of weevils, by which their

quantity

quantity is diminished one-fourth, and sometimes even one-third. It consists in keeping them in casks or sacks with ashes or lime, from which they are easily cleansed when wanted for use.

Economical Furnaces or Kitchens.

At a late meeting of the Athenæum of Poitiers, M. Couteault, inventor of the economical furnaces or kitchens, developed the numerous advantages obtained by that invention, as the saving of fuel, expedition in cooking, the improved quality of the victuals, the facility of heating several apartments with pipes adapted to them, &c.

List of Patents for Inventions, &c.

(Continued from Page 320.)

EDWARD THOMASON, of Birmingham, in the county of Warwick, Button and Toy Manufacturer; for an improved mode of making pikes. Dated February 7, 1804.

MARCUS HYMANS, of Exeter-street, Covent Garden, in the county of Middlesex; for a composition for shaving without the use of razor, soap, or water. Dated February 7, 1804.

WILLIAM HYDE WOLLASTON, of Buckingham-street, Fitzroy-square, in the county of Middlesex, Gentleman; for an improvement in spectacles, by the application of concavo-convex glasses to them. Dated February 7, 1804.

THOMAS PASSMORE, of Doncaster, in the county of York, Machine-maker; for an improved machine for chopping of straw, and for splitting beans, crushing oats, and grinding malt and barley. Dated February 7, 1804.

[redacted]

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XXIV. SECOND SERIES. May 1, 1804.

Specification of the Patent granted to WILLIAM HYDE WOLLASTON, *of Buckingham-street, in the County of Middlesex, Gentleman; for an Improvement in Spectacles, by the Application of Concavo-convex Glasses to them.* Dated February 9, 1804.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Hyde Wollaston do hereby particularly describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say: The object of my said invention is to remedy the following defect, which has been observed in spectacles heretofore in use, *viz.* that no objects appear distinct through them but such as are seen through the centre of the glasses, or nearly so, but are indistinct in proportion to the distance of the part of the glass through which they are seen from the centre,

whether sidewise or upwards or downwards; that is to say, the indistinctness is greater in proportion as the rays of light passing from an object to the eye pass more obliquely through the glass, as is represented by the lines E, O, in Figs. 1 and 2, (Plate XVI.) in which E is the place of the eye, and A O in each is a section of a spectacle-glass, of the common defective construction. I have found that the defect above mentioned may be remedied by means unnoticed by the best practical opticians, and contrary to the opinion of the most celebrated writers on optical subjects.

Having observed that the portion of any glass employed in any one position of the eye is small, I perceived that by making the substance of a glass curved in the manner of a hollow globe, each portion of it might be situated nearly at right angles to the direction of the sight, and would thereby render lateral objects distinct without impairing the distinctness at the centre. My invention therefore consists in the application of this principle to spectacles; and my method of doing so is by having the glasses thereof of a form not heretofore used for that purpose; and the form of the said glasses is such, that the outer surface of each glass, or that which is farthest from the eye, is spherically convex, and the inner surface of the same glass, or that which is nearest to the eye, is spherically concave. A section of this form of glass, as represented by the drawing, Fig. 3, is adapted for a short-sighted person, having the interior and concave surface of each glass more curved than the exterior and convex surface of the same glass, by which the rays of light passing through the same are diverged, and the degree of curvature of the interior and concave surface is to be increased in proportion as the person to use the glasses is the more short-sighted.

For

For long-sighted persons, the form of each glass must be such as to have the exterior and convex surface thereof more curved than the interior and concave surface of the same glass, as is represented by a section of the said form of glass in the drawing Fig. 4, by which the rays of light passing through the same are converged; and the degree of curvature of the exterior and convex surface of the glass is to be increased in proportion as the person to use the glass is more long-sighted.

The methods of preparing such glasses, and of proportioning their curvature, so as to give them any power of magnifying or diminishing that may be required, and to suit the different sights of long and short-sighted persons, are too well known to persons skilled in optics to need any description.

In witness whereof, &c.

Specification of the Patent granted to JAMES BENNET, *of Oldham-street, Manchester, in the County Palatine of Lancaster, Manufacturer; for a Method of felting Woollen Cloth, and also of felting Cloth manufactured of Sheep's Wool, and other combined Materials.*

Dated March 10, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that the following is the nature of my said invention, and the mode, method, and manner in which the same is to be performed, used, and put in practice; that is to say: After such cloth has been manufactured by the weaver, and the same has gone through the usual regular processes of cutting, scouring, and cleansing, or such of them as the particular manufacture may require,

 it

it must be immersed in hot water, a little below the boiling-point, and remain in that state till it has imbibed a moderate warmth. It must then be taken out, and laid on a large polished flagged stone; which stone must be placed on a frame, having a roller at each end, for the purpose of receiving the cloth, which must be wound tight over one of such rollers, the flag-stone having been previously heated pretty warm by means of pouring hot water on it. One end of such piece of cloth must then be drawn tight over the surface of the stone, and fixed to the roller at the other end; when so fixed, hot water, a little below the boiling point, must be poured on such cloth as it lies on the stone; and the surface of such cloth must then be rubbed or worked in that state with a polished marble, or some other hard body having a polished surface, by hand or with machinery, with a light pressure, until the workman perceives a stiffness in the friction, which will be produced by the marble, or other polished body, working the water off until the cloth becomes nearly dry; when the same process of pouring the hot water on the cloth, and expelling it again by friction, must be repeated until the felt required be produced; which processes will produce a felt, and cause the body of the cloth to unite in a sound substance. The above method may be used either with or without soap; the latter mode being found most beneficial to the substance of the cloth, and causing it to take the felt more expeditiously, is therefore recommended to be preferred. The cloth may then be dyed and finished to any colour, at the discretion of the manufacturer.

In witness whereof, &c.

Specification

Specification of the Patent granted to MARCUS HYMANS, *of Exeter-street, Covent Garden, in the County of Middlesex; for a Composition for Shaving without the Use of Razor, Soap, or Water.*

Dated February 7, 1804.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Marcus Hymans do hereby declare, that the said composition for shaving, as aforesaid, is prepared and used in the manner following; that is to say: Mix one pint and an half of clear lime-water, two ounces of gum-arabic, an half of an ounce of isinglass, an eighth of an ounce of cochineal, a quarter of an ounce of turmeric-root (made into powder), an eighth of an ounce of roach allum, an eighth of an ounce of salt of tartar, and an eighth of an ounce of cream of tartar, together; boil them for one hour at least, (stirring up the mixture during the whole time of boiling, and being careful not to let it boil over,) clear it through a sieve; then add two pounds and an half of iron pumice-stone, finely pulverized; mix the whole together, with the hands, into one cake, by the assistance of the white of two eggs, well stirred up. Then divide the cake, so made, into twelve smaller cakes; dry them in the open air for three days; put them into an oven of moderate heat for twenty-four hours, when they will be completely dry and fit for use. Apply them with a gentle friction to the beard, and they will produce the complete effect of shaving.

In witness whereof, &c.

Specification

Specification of the Patent granted to GEORGE MEDHURST, *of Battle-Bridge, in the Parish of St. James, Clerkenwell, Engineer; for a condensing Wind-Engine, capable of being applied to all Kinds of Purposes in which either Steam, Wind, Water, or Horses are used.*

Dated February 28, 1799.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said George Medhurst do hereby declare that the nature of my said invention is described in the drawings hereunto annexed, and in the manner following: First, I condense the air of the atmosphere (by machinery to be described hereafter) in a strong and close vessel, which I call the magazine, by means of a windmill, so as to make it from ten to twenty times more dense than it is in its natural state. Secondly, I conduct that dense air from the magazine through a pipe to the top of a cylinder, where it acts upon a piston, by its elasticity, without the aid of fire, and by these means keeps the machine in constant motion for a time, proportioned to the capacity of the magazine, though the wind do not blow. The object of my invention is to accumulate and preserve the irregular power which the wind produces, so that it may be applied to machinery to produce an uniform and regular motion whenever it is wanted. The windmill sails I construct in the usual vertical manner; or when a greater power is required than can be obtained in that manner, I construct them as follows. A broad ring or hoop of wood or metal B B B B Fig. 1, (Plate XV.) is fixed upon the extremity of the Arms C C C C, having a smaller one A A A A concentral with it, and of such diameter as to include about one-

one-half of the space included by the first. The two rings are supported by the arms C C C C, which extend from the axis to the outer ring, and against the wind by rods of metal, from the extremity of the axis continued out beyond the plane of the sails for that purpose. The sails are fixed between the rings A and B sufficient in number and size to fill nearly the whole of that space, leaving it open within the smaller one to allow the wind a free passage.

To apply my machinery to a windmill previously built, I fix a wheel B, Fig. 2, upon the upright shaft of the mill, which turns another wheel C fixed upon an horizontal one. Upon the rim of this wheel, as at D, is a strong pin, which takes hold of the end of the rod D D, the other end of which is jointed into the piece of timber E E; and on the lower end of this piece is an iron wheel, without teeth, to run upon the inclining plane F, which plane is set at a greater or less angle by means of the screw F G. The upper end of the piece E E is jointed into the beam H, which turns upon a fixed centre at I, and is jointed, at the other end, to the rod of the condensing piston L, which works in the barrel M, and to this barrel is screwed the pipe N, which leads to the magazine placed without the building, or under ground, as most convenient. There are two valves, P P, at the bottom of the barrel; one to admit the air into the barrel from the atmosphere, when the piston ascends, and the other to admit the air from the barrel to the magazine, when condensed by the descent of the piston. As the wheel C is turned round, it draws the rod D D, by the pin D, which drives the wheel E up and down the inclining plane, whereby the end of the beam H is made to rise and fall, and to work the piston-rod at the other end.

By

By means of the inclining plane and screw, the condensing piston is made to work a long or a short stroke, according to the strength of the wind, and the density of the air in the magazine. When the wind is strong, or the air in the magazine not much condensed, the inclining plane is to be set at a great angle, that the piston may make a long stroke, and drive into the magazine a greater quantity of air; but when the wind is weak, or the air in the magazine strongly condensed, the inclining plane must be set at a less angle, but which, of course, should be the greatest at which it will work. By these means, the full effect of the least wind will be obtained, as well as of the greatest; and, in consequence of the wheel at the end of the piece E E being drawn up to that point F, on which the inclining plane turns, the condensing piston will go to the bottom of the barrel every stroke, whether the angle is great or small.

To raise and depress the inclining plane, as occasion requires, I construct a regulator as follows:

The horizontal wheel *a*, is fixed upon the iron spindle *a a*, and is turned by the wheel B; and upon two round parts, near the bottom of the spindle *a a*, are placed two mitre wheels, X and W, which have each of them round holes in their centres, that the spindle *a a* may turn round within them, while they remain stationary. The teeth of each of these wheels work in the teeth of another vertical wheel Y, fixed upon the end of the long spindle Y N; and upon the other end is fixed the wheel N, the teeth of which work in the teeth of the wheel O, and this last wheel is fixed upon the nut of the screw G; so that whenever the wheel O is turned round either way, the screw G, with the inclining plane, is either raised or depressed. That part of the spindle *a a*, that is between the wheels X and W, is square, and has upon it a

coupling

coupling-box V, made to slide up and down between the wheels; this coupling-box is connected, by the rod L, to a centrifugal regulator, made in the usual manner, and kept in constant motion by the spindle *a a*. As the balls of the regulator are thrown farther from their centre of motion, by the increased velocity of the windmill, the coupling-box V will be drawn up by the rod L, so as to take hold of the wheel X, and cause that wheel to turn round with the spindle *a a*, whereby the wheel O, with the nut of the screw, will be turned, and the angle cf the inclining plane increased. But when the velocity of the windmill is so small, that the balls of the regulator fall close in, the coupling-box V will be let down, so as to let go its hold of the wheel X, and take hold of the wheel W, whereby the wheel O, with the nut, will be turned the contrary way, and the inclining plane set at a less angle. By this means, the engine will adjust the inclining plane, so that the quantity of air driven into the magazine will always be the greatest that the strength of the wind, and the charge of the magazine, can admit of.

When the windmill is erected for the purpose of a condensing wind-engine, and the situation and circumstances permit, instead of the upright central shaft A, and wheels B and C, I make a cast-iron crank upon the middle of the axis of the sails, as *a*, Fig. 3; to this crank a rod is attached, which reaches to the lower part of the building, and takes hold of and turns in a socket at the end of the cast-iron piece *e f e*; this piece turns upon a fixed centre at *f*, and to the lower end of it is jointed the rod D, which moves the wheel upon the inclining plane, as described in Fig. 2; and I apply the regulator to this machinery by means of a small fly-wheel and crank, communicating by a rod to the lower end of

 the

the piece *e f e*. Q, Fig. 2, is the pipe through which the dense air passes from the magazine to the cylinder R, which is either closed at top and bottom, and has a cylindrical rod and stuffing-box, as is usual in steam-engines, with a joint and roller at *q*, to keep it parallel, or is open at bottom, and is connected, by the rod under the piston, to the frame S S, as represented in the figure. The cylindrical rod, or the frame S S, is jointed to the end of the beam T, which turns upon a fixed centre at W, and to the other end of it is jointed the heavy iron rod W, which is connected to the crank of the fly-wheel Z; to this end of the beam also the pump-rods are connected, when the engine is applied to raise water: or, instead of applying the rod W immediately to the crank, I connect the end of it to the two short pieces B B, Fig. 4, one of which turns upon a fixed and firm pin at C, and the other is jointed to the rod D, which rod is connected to the crank, and by this means the fly-wheel receives a double velocity. There are two valves at the top of the cylinder R, Fig. 2, to be opened and shut by the engines, one to admit the air from the magazine into the cylinder, and the other to let the air out of the cylinder, when the piston is driven to the bottom. In consequence of the air in the magazine being at different times of various degrees of density, the valve that admits the air from the magazine must be shut, when the piston, in its descent, is at different distances from the top of the cylinder, that the quantity of force which the piston receives, in the whole descent, may be equal, although the density of the air is different; and this is to be managed by placing the sliding rod, that shuts the valve, higher or lower, on the frame S S, and may be made to adjust itself by a regulator.

Fig.

Fig. 5 represents an air-vessel and piston, by which a rotary motion is obtained without valves, applicable to small engines, or where a fly-wheel cannot be admitted; A C E D B is a section of the vessel, made of cast-iron, having a curve, superficies, and flat ends. In the inside of the vessel, and round the curve, runs a flat spiral division, fixed to the curve, and close to the boss of the axis O P; this spiral passes round from A to B, from B to C, from C to D, and from D to E, where it ends. The axis I L passes, through one of the flat ends of the vessel, through the middle of it, and terminates in the opposite end, and has a boss O P upon it, which fills up the middle part of the vessel; the boss, and part of the axis, has a longitudinal slit through it, to admit the flat circle A C E S T to turn within it, on a centre at N; this circle is divided into equal leaves, each of which fit the space between the spiral division. The dense air admitted at F will press upon the leaf that occupies the space between A and C, and drive it round together with the axis I L; as the leaf goes round, it passes between B and D, and thence to C and E, when another leaf of the circle will have entered between A and C, upon which the air from the magazine will act as before; the air, when it is dilated, and has left the spiral, will issue out of the hole *a*.

The form of the magazine I make spherical, or cylindrical, with semi-spherical ends, according to the situation and circumstances; and the materials, copper, plate-iron, or cast-iron; and when large, cast or wrought into segments, and screwed together, and paint and varnish the inside, to make them air-tight; and where it is practicable, I make an excavation under ground, so much below the surface, that the incumbent earth may be sufficient to resist the force of the confined air, and line the excavation with lead, copper, or cast-iron, or with bricks or

tiles cemented together, and covered on the inside with pitch, paint, varnish, or any bituminous matter, to render it air-tight; and to and from the magazine conduct the air by a strong cast-iron pipe, on or near the top of which must be a safety valve, for the security of the magazine, and a stop-cock, to close the pipe occasionally. In witness whereof, &c.

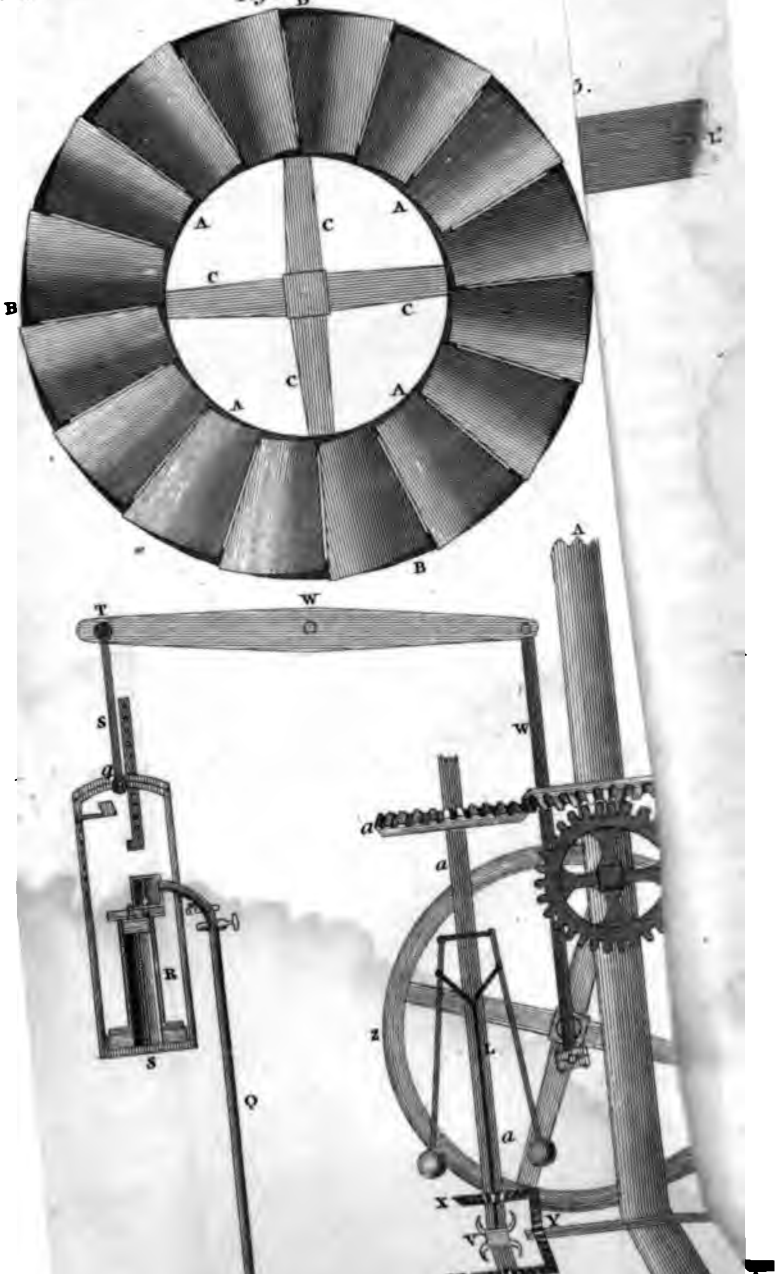
Account of a Method of gaining Land from the Sea. By Mr. JOHN KNAPPING, *of South Shoebury, Essex.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal was adjudged to Mr. KNAPPING *for this Communication.*

IN the month of April, 1801, I entered into an agreement with some men who had been accustomed to make embankments against the sea, to enclose 234 acres of saltings, or broken ground, which I had hired, upon lease, of the Right Hon. the Earl of Winchelsea, in the island of Foulness, and which was overflown by the sea every tide. I could have enclosed nearly 20 acres more at the same time; but did not deem it prudent, because in that case the base or foot of my new bank must have been set too near the ocean; and by that means the surge, when the wind blew hard from the East, or North-East, would have been liable to damage and undermine it. The base or seat of my new wall is 32 feet; and I first contracted to have it only six feet high, and to be six feet wide on the top: to complete which, I agreed to give the men 58 shillings per rod. There are 304 rods of it, and the

Fig. 1.



he work so executed came to 881*l.* 12*s.* But, judging afterwards that its base would still bear an additional height, which I conceived to be necessary for the better security of the land, I had the wall or bank made a foot higher, and allowed a contraction of one foot more for the slope, or *batten*, as it is termed; so that its dimensions now are 304 rods in length, 32 feet base, seven feet perpendicular height, and five feet wide at the top. This additional height cost me about 150*l.* more, which, added to the price of the first contract, and the planks for the workmen to wheel their barrows upon, &c. made the whole cost of the embankment amount to very nearly 1100*l.*

This wall, or bank, is entirely formed of earth, a considerable part of which I obtained by cutting a ditch, or *delft*, as it is usually termed, about nine feet wide, and about fifteen feet from the foot or base on the land side of the wall. This delft serves as a reservoir to take off the rain-water from the newly-inclosed land, which is conveyed through the wall, or bank, into the sea, by a sluice or gutter, which is open when the tide is out; and through which gutter also the salt water can be let in, when necessary, to fill the delft or the ditches cut between the different fields, or enclosures, to keep cattle apart, &c. By the end of the month of October, 1801, this undertaking was completed, and the wall, or bank, remains firm and good, and will receive considerable strength and stability by sowing the seeds of the couch grass thereon, and feeding the same closely with sheep.

Before the land was thus enclosed, no use could be made of it, except that of grazing it occasionally with a few sheep when the tide was gone off. It now begins to grow quite solid, and will already bear the weight of a large bullock. It naturally begins to produce a sort of fine

fine grass, which sheep in particular are very fond of, and which is of a wholesome quality, but not as yet very nutritious, or fattening. That property, however, it will acquire more and more every year; and it will, I doubt not, in the course of less than twenty years, be as good grazing land as any on this level, and may by that time be converted into tillage, if required.

In addition to the preceding statements respecting the land gained from the sea, by Mr. J. Knapping, in the island of Foulness, the following observations, by Mr. J. Wise, of Rochford, may probably be of some use for the perusal of those concerned in embankments of that nature.

In one of my first descriptions of the island in question, you will recollect that I said the greatest part thereof belongs to the Earl of Winchelsea; and, among the number of farms in that place, that which Mr. J. K. now occupies, called East-Wick farm, is one of those which are the property of his Lordship. At the expiration of the last lease of the said farm, the old tenant refused it upon the terms offered to him; and among those who applied to rent it, was the present tenant, who voluntarily proposed to enclose, embank, and secure the saltings adjoining thereto, as they are termed, at his own cost and charge, provided that his Lordship would agree to grant him a lease upon certain terms and conditions then specified. With these proposals his Lordship was well pleased, and not only granted him a lease for twenty-one years, at a certain rent, but likewise made the like propositions to another tenant who held a farm adjoining; and to these propositions the other tenant also acceded. Had the tenants not agreed to enclose the saltings, it is probable

probable that his Lordship would have undertaken it at his own expense. But it must appear to be much more eligible, to every thinking man, for the tenant than for the landlord, in such cases, to do it; because the tenants are more likely to understand the nature and the mode, as well as the expense of embanking, than their landlords; and all that the landlord has to do, when such a thing is taken in hand by his tenant, is to see that it is done substantially. Under these circumstances Mr. J. K. undertook the matter in question; and he has completed it in a very superior manner.

His next object then was to discover and pursue some plan by which both himself and the community might be most benefited by this new inclosed land. It had been found by others, in similar cases, that to break up and convert such land into tillage too soon, would not answer; for the quantity of salts with which it is impregnated is so very great, that, when exposed to the sun, &c. they completely chrystallize the soil; and although the green corn, during the winter and spring months, may have a luxuriant and healthy appearance when sown thereon, yet, as soon as the earth begins to get dry, it is scorched and burnt up, so that scarcely any of it arrives at perfection. The plan, therefore, to which Mr. J. K. resorted was, that of stocking it hard with sheep, and small Welch or Scotch cattle, which will eat a sort of weed provincially termed Lamb's Tongue (somewhat resembling the *sweet gale* in appearance, but not in smell), and which sheep in particular are fond of. By feeding it closely with sheep (and of these the Welch, Norfolk, or Southdown sorts, are to be preferred), the land becomes every year more solid, the briny particles subside, and a sort of very fine small grass naturally begins to grow, within the course of eight or ten years after it has been embanked; and,

and, in less than fifteen years, it may be converted into tillage, and will produce wonderful crops, sometimes of mustard-seed, &c. But as these pernicious crops are what no tenant ought to be suffered to grow, so will it be the utmost wish of the present tenant to avoid growing them; for they usually so taint the soil, that they can never afterwards be eradicated or destroyed. The best way is to pursue the grazing system above alluded to, for at least the first fourteen years; and then, having previously laid out and divided the land into separate inclosures, it may be converted into tillage for corn, and that to advantage. An excellent mode of managing such land, if it is meant to be tilled, is to lay about eight waggon-loads of chalk upon every acre, when it has been embanked about fifteen years, and not to plough it till five or six years afterwards. It will then grow any sort of grain, and especially oats, beans, and wheat, in great abundance, and of most excellent qualities. Such is the process of management which the present tenant means to pursue; and there is scarcely a doubt, but it will answer his warmest expectations, should his noble landlord allow him sufficient encouragement to pursue it.

I beg leave to make another remark before I conclude this Essay; and it is this. If a quantity of the seeds of the cooch grass be sown; or, what is still preferable, if the roots of that grass be planted upon the bank, or mud wall, when it is first formed, that, with the treading of the sheep, &c. will tend much to strengthen its texture, and to preserve it from being injured by the tide.

From another letter of Mr. Knapping, it appears that he began to undertake this embanking about the beginning of the month of April, 1801, and that in the month of September following the whole was completed; that upwards

wards of 230 acres of land were effectually inclosed and secured from the sea, at a very considerable expense, viz. one thousand pounds and upwards; and that this land is already converted into pasture, capable of feeding a great number of sheep, and even bullocks, and is likely to become, in the course of a few years, fit for tillage, or any purpose to which land can be converted.

The above statement is confirmed by the Certificates,

T. Ellwood, Curate of Foulness.
Wm. Potton, Churchwarden.
T. Wiggins, Overseer of the Poor.
Edm. Witton, }
F. Bannester, } Inhabitants.
W. Meakens. }

Account of Experiments on feeding Cattle with Potatoes. By John Christian Curwen, Esq. *M. P. of Workington Hall. Communicated to the Society for the Encouragement of Arts, &c. in a Letter to their Secretary.*

From the Transactions of that Society.

The Silver Medal was voted to Mr. Curwen *for these Experiments.*

In a letter, which I had the pleasure of addressing to you some time ago, I took the liberty of hinting at an experiment I was making, in giving Steamed Potatoes as a substitute, in a great measure, for Hay.

I was then wholly unacquainted with its having been tried. It was from my friend, the Bishop of Landaff, I first learnt that the Board of Agriculture had made a re-

port upon it. As I do not find that was carried to any great extent, nor given in the way I have done, I shall, with much deference to the Society of Arts, &c. offer what has occurred to me, together with the plan I have adopted for steaming and washing. Having nothing of the kind to assist me in my beginning, I found great difficulty and much time consumed, which I trust this will remedy to those who may be inclined to make the experiment.

My respectable friend and neighbour, the Bishop of Landaff, took the trouble of examining the process, and inquiring into every thing relating to it, and has certified the complete success of the plan, and his approbation of the apparatus. It was in consequence of the alarming failure in the hay crop of the year 1801, that I found myself called upon to take some steps to prevent the serious consequences which were likely to result from it. The importations of hay from Ireland, in August, were from 9*d*. to 11*d*. per stone of 14 pounds. In this situation it fortunately occurred to me, that I had for many years given a proportion of Steamed Potatoes, mixed with the other food, to my hounds, and found it to answer extremely well. If hounds could stand their work with this feed, I could scarcely admit a doubt of its being a hard as well as nutritious food. Under this impression, I began my steaming in October, 1801, and continued it till late in May. The prejudices I had to encounter were such as would have defeated the plan, had I not followed it up for some months, with constant and unremitting attention; and whoever attempts it will have difficulties to contend with, that require particular attention to overcome. In no one instance did it fail, and my horses were never in such spirit and condition. In October last I recommenced my operations, and am able to steam from 160 to 200 stone,

[redacted]

stone, of fourteen pounds each, per day; I have fed upwards of eighty horses constantly both seasons; and this year I have extended the feed to my milch cows, taking away all hay, and only giving a little straw. Each horse has a stone and a half of potatoes, or twenty-one pounds, estimated at 3*d.* per stone—4½*d.*; steaming, a halfpenny; ten pounds of bruised corn, 6*d.*; five pounds of hay, 2*d.*; two pounds of cut straw to mix with the corn, a halfpenny; making on the whole, 13½*d.* per day. Each tub of potatoes, containing eleven stone, has one of cut straw mixed up with it; it is given warm, and a horse will eat a stone in less than half an hour, whilst between six and seven would be required to eat a stone of hay. The time gained for rest contributes greatly, I have no doubt, to promote the health and condition of the horses.

The facility with which potatoes can be transported from place to place is much in their favour, and being without damage, to which hay is liable, is a further object. The individual gain will be found great, where ground is highly rated and not easily procured, as will be commonly the case where horses are most wanted. In a national point of view, it may be important, should the population of the country advance as rapidly as it has for some years past. The potatoe crop is produced from ground which would otherwise be under fallow; and when proper care is taken, the wheat after potatoes is equal, if not superior, to that from fallowed ground. The year previous to my adopting my present method, I sunk the rent of my farm, valued at a thousand pounds (about 700 acres), and seven hundred pounds besides. In the last year I cleared, receiving the same prices for my work, 2189*l.* The only difference I can point out is in the price of oats; this might deduct 300*l.* I had forty acres last year under potatoes; the wetness of the ground,

and the very unfavourable season, made my crop a bad one. I shall have this year sixty. I have found no difficulty in importing from Scotland and Ireland, at 3*d.* and 3½*d.* per stone. The quantity being more than I required, I have sold to the poor at reduced prices at 3*d.* whilst the markets were from 5*d.* to 6*d.* I had 300 acres under hay, and never sufficient; I expect that 150 now will be more than sufficient for all my wants. The value of hay was heretofore in proportion to my necessity; having no longer occasion for any, the price will fall to the neighbourhood. Indeed, it has, as I might purchase at 6*d.* per stone, what was seldom or ever under 9*d.* and more frequently a shilling; I have every pound of hay weighed, so as to prevent all waste; and though this is some trouble and expense, I have reason to believe it is amply repaid by the economy it enforces.

I beg pardon for the unreasonable length of this letter. Without a considerable degree of enthusiasm, I should never have got through with my undertaking; and the Society will, I hope, excuse me, if I have attached more importance to the matter than it deserves. If any farther information should be wanted, I shall be happy to give it.

P. S. I make no difference in the feed of a cart horse, or one of my carriage horses; the allowance is the same. The coals for steaming 160 stone of potatoes, I have found to be two Winchester bushels and a quarter, or 137lb. of coal.

	£.	s.	d.
One labourer also is sufficient to steam, wash, &c. 160 stone - - - - - -	0	1	8
Two Winchester bushels, and a quarter of coals, at 3*d.* each bushel - - -	0	0	7
	0	2	3

The

	£.	s.	d.
The cost is therefore under a farthing per stone, leaving a residue of 13*d.* per day, which in six months would produce - - -	9	15	0

The cost of the apparatus, washer - -	12	12	0
Four tubs, at 2*l.* 2*s.* each - - - -	8	8	0
Boiler - - - - - - - - -	5	5	0
Platform for the tubs - - - - -	10	10	0
Pump - - - - - - - - -	5	5	0
Building - - - - - - - -	60	0	0
	102	0	0

In addition to the preceding account of my experiments on potatoes, I wish to add a few observations, to guard such as may be inclined to make the experiment of feeding with them, against the pernicious effects of the liquor which distills from the potatoe, The first attempt I made to give potatoes to hounds, was fifteen years ago: they were boiled with their other food; but I was soon obliged to desist from it, the hounds being very violently purged and affected by it; from this trial I was satisfied, that the potatoe liquor contained a very poisonous quality, which must be highly pernicious. Indeed, I have no doubt, if any animal was suffered to drink the water which comes from the potatoe, it would be destroyed by it. It is upon this account I adopted the leaden cistern upon which the tub rests, and into which the steam is introduced. Though I am satisfied there is a great loss of steam by it, and an increased expenditure of fuel, yet to keep clear of the potatoe liquor

quor mixing with the potatoes. is of the first importance. As a remedy against the loss of steam, I should advise to lengthen the steam-pipe in the cistern, so as to throw the steam to the centre of the tub, and to have a hole cut, and covered with a leaden cap, with holes for the steam to pass through, by which means the condensation will fall by the sides of the tub, and much steam be saved. The potatoes are made much dryer, by suffering them to stand a few minutes in the tub, after the steam is taken from them.

I had so little assistance from any thing previously done in steaming, that the first season it required five men to do the work which one man can now accomplish with ease. It took two persons to wash them, which they did in a very incomplete manner; two to steam and bruise, and one man and a horse to furnish water. The washer will be found to answer the purpose admirably well; and when the saving of water is an object, its value will be increased. Several private families have adopted them upon a small scale, and found great convenience from it. I believe the method I have adopted, of mixing a portion of cut straw (from a tenth to an eleventh part), is highly advantageous; first, as it prevents the food passing too quickly, and secondly, as it keeps the mouths of the horses from being clogged with the potatoes. Should doubts still remain, as to the performance and health of the horses thus fed, I am ready to afford unquestionable proof from the persons who have the care of them. I shall always be ready to answer any questions, or to afford any farther information in my power.

From what I have previously stated, the advantages I have already reaped from this method will be apparent; and I cannot but sincerely wish, both for the advantage of the publick and individuals, that through the medium of

of your most useful and respectable Society, it may come recommended to them, which cannot fail of having considerable effect.

P. S. When the potatoes are sufficiently done, being of a heat equal to the steam, the distillation ceases, and the steam comes through the cock. The condensed water from the steam formed during the operation, is allowed to run off, affording a constant stream.

The above statements were confirmed by Certificates from the Bishop of Landaff, and Arthur Young, Esq.

Observations on the Chay Root, a Species of Madder used for Dying durable Red Colours in the East Indies, with a Method of using it with Advantage in English Calico Printing. *By* J. Fleming, *Inspector of Drugs.* *Communicated by* John Stockwell, *Esq. to the Society for the Encouragement of Arts,* &c.

From the Transactions of that Society.

THE following Paper was drawn up by Mr. Fleming, agreeably to the desire of the Board of Trade of the India Company, signified to him by their Secretary, W. A. Edmonstone, Esq.

It is rather surprising, considering the pains that have been taken in Europe to discover, or at least to imitate, the method of dying the Turkish or Adrianople red, that so little attention has been paid to the equally beautiful and permanent red given to their calicoes by the natives of the coast of Coromandel. Although full accounts of the practice of calico-printing in the East Indies were sent home long ago by the missionary Cœur Doux, M. Poivre,

Poivre, and others, it does not appear that the European artists have ever tried their skill in the Chay root, the drug by which the admired red colour is produced. I have never heard, at least, of any such attempts, nor do I believe that the root has ever been sent home. It is evident, from the manner in which this drug is mentioned by Dr. Bancroft, in his "Experimental Researches," p. 174, that well-informed writer had never seen it, which I think could scarcely have happened, had it been at all known to the London dyers.

It is probable that the tediousness of the Indian process, as described by those who sent home the accounts of it, consisting of many tiresome manipulations, continued during a period of nineteen or twenty days, deterred the European artists from trying the effects of the Chay root in dying or printing their cottons. What may appear more extraordinary is, that the same cause, co-operating perhaps with the natural indolence of the people, and their having cheaper, though inferior, red dyes at hand, has prevented the use of this root from obtaining in Bengal; for, so far as I can learn, it is not used in this part of India. The natives here are content with the red produced by the *Aul Munjiet*, and other drugs, though the colours yielded by these are far inferior to those of Madras calicoes. On this account I am surprised at the measure which has been adopted, of sending round hither such a large quantity of the Chay root from the coast. I apprehend very little or none of it will be purchased at the approaching sale, in which case it must be either returned to Madras, or sent to England. The expediency of this last measure must depend on the possibility of so abridging the process of dying, or printing cottons with Chay root, that the English artists may find it worth their while to have recourse to it for the reds and

purples,

purples, instead of the Smyrna madder, or whatever other drugs they use for those purposes at present.

To ascertain this point, I have, agreeably to the instructions of the Board, made several experiments with the Chay root; indeed as many as the shortness of the time, and my other avocations, would permit. From the result of these trials, I entertain great hopes that the English calico-printers will not only shorten the process so much as to finish it within a tenth part of the time required for the Indian process, but that they will by the Chay root dye their cottons of a brighter red than can be done by madder, or any other vegetable.

It is needless to detail the many trials I made, which either failed altogether, or succeeded in a very imperfect degree. I shall therefore only mention that process which I found to answer best, and by which the piece of cotton cloth, which I herewith send you for the inspection of the Board, was printed. Having made a decoction of two ounces of powdered *Hurr* (the fruit of the Myrobolona Citrona *) in a quart of water, I took a piece of Madras cotton cloth, and boiled it in the decoction for about half an hour. Having taken out the cloth, and washed it well with cold water, I dried it in the sun, and afterwards had it properly ironed and smoothed for the pencil. I then took some of the acetite of alumine, made in the manner directed by Dr. Bancroft, and thickening it properly with gum-arabic, I delineated a flower with this mordant upon the cloth, and dried it in the sun. I afterwards washed the cloth in cold water, to clear it of the superfluous acetite, and dried it again in the sun. I then infused about two ounces of the Chay root, coarsely powdered, with about a quart of water, in a vessel well

* Aleppo galls will probably answer as well as the Hurr.

tinned, and setting it on the fire, as soon as the liquor began to grow warm, I put the cloth into it, and let it remain until it had boiled about half an hour, during which the cloth was frequently stirred. I then took it out, and having rinced it well with cold water, I put it to dry in the sun. The delineation of the flower now appeared of a good bright red, and the ground of the cloth, though slightly tinged, was much less so than I expected. By washing it again with cold water, and afterwards with soap and water, and exposing it for a whole day to the sun, during which it was frequently besprinkled with water, I brought it to the state in which you now see it. The whole process has only taken up about six and thirty hours. I should have mentioned, that the washing with soap heightened the brightness of the red considerably.

Making allowance for my want of experience in the practice of dying, and considering the great improvement which may be expected in the process from the superior skill of the English artists, I think we may conclude, even from this imperfect essay, that the Chay root will be a valuable acquisition to the English calico-printers. I therefore recommend, that so much of the root as may remain unpurchased at the sale, or at least that a part of it, may be properly packed up and sent to England by one of the ships now under dispatch.

This drug is the root of a plant called by the botanists *Oldenlandia Umbellata.* I have not met with it in this part of India; but it grows naturally on the coast of Coromandel, where it is also cultivated in great abundance, for the use of the dyers and calico-printers.

The sample which you sent me appears to be of a good quality, and in good condition. It is said that the root will remain with its virtues entire for several years, and that

that they are even improved by keeping. If this be the case, and provided the dyers at home find it answer, this circumstance is a very favourable one, and must enhance the value of the drug as an article of commerce.

Minute of the Board of Trade, dated April 10, 1798.

The Board are of opinion, that the result of the inspector's experiments will afford very acceptable information to the calico-printers in England; and if their operations should prove his ideas to be well founded, the plant may prove a valuable acquisition to the manufacturers of Great Britain, and also an article of commerce from the coast particularly useful, as there is a want of coast articles of low value, as well light, as a sufficiency of ponderous, to make up a proper cargo for a large ship, without swelling its value to too great a risk, as would be the case were a ship to be loaded entirely with piece goods.

Account of the Method used in recovering the Dutch Frigate Ambuscade, *of* 32 *Guns, sunk near the Great Nore. By Mr.* Joseph Whidbey, *Master Attendant in Sheerness Dock Yard.*

From the Philosophical Transactions of the Royal Society.

At eight o'clock in the morning of the 9th day of July, 1801, the Dutch frigate Ambuscade left the moorings in Sheerness harbour, her fore-sail, top-sails, and top-gallant-sails being set, with the wind aft, blowing strong. In about thirty minutes she went down by the head, near

the Great Nore; not giving the crew time to take in the sails, nor the pilot or officers more than four minutes notice before she sunk; by which unfortunate event twenty-two of the crew were drowned.

This extraordinary accident was owing to the hawse-holes being extremely large and low, the hawse-plugs not being in, and the holes being pressed under water by a crowd of sail on the ship, through which a sufficient body of water got in, unperceived, to carry her to the bottom.

The instant she sunk, she rolled over to windward across the tide, and lay on her beam-ends; so that, at low water, the muzzles of the main-deck guns were a little out of the water, and pointed to the zenith, with thirty-two feet of water round her.

The first point I had to gain, was to get her upright. Before I could accomplish it, I was obliged to cut away her fore-mast and main-top-mast; which had no effect, until the mizen-mast was also cut away; she then instantly lifted her side, so that at low water the lee railing on the quarter-deck was visible.

By proceeding in this manner, the first part of my object was obtained, with a secured main-mast, and all its rigging, to enable me, should I be fortunate enough to weigh the ship, to lighten her by it with the greatest possible expedition.

The ship being in the forementioned state, gave me an opportunity, the next low water, to get out her quarter, forecastle, and some of her main-deck guns, with a variety of other articles.

I next proceeded to sling her; which was done with two nineteen-inch cables, divided into eight equal parts. The larboard side of the ship being so much higher than the starboard, enabled me to clench each of the ends round

round two of the ports, excepting one that was clenched round the main-mast; and with great difficulty, by long rods and diving, I got small lines rove through four of the ports on the starboard side, by which means I got four of the cables through those ports across her deck, which were clenched to the main-mast and larboard side, having four ends on each side completely fast, at equal distances from each other. I brought the Broederscarp, of 1063 tons burthen, out of the harbour, which received the four ends on the starboard side; also four lighters, of 100 tons each, which took in the other four ends, on the larboard side, over their bows. All the eight ends were at low water hove down with great power, by a purchase lashed distinctly on each of them. I then laid down two 13-inch cables, spliced together, with an anchor of 24 cwt. in a direction with the ship's keel. On the end of the cable next the frigate a block was lashed, through which was rove a 9-inch hawser, one end of which was made fast to the ship; the other end was brought to a capstan on board the Broederscarp, and hove on it as much as it would bear, with an intention to relieve the frigate from the powerful effect of cohesion. This had so far the desired effect that, at about half flood, I perceived the ship to draw an end, and swing to the tide; and all the slings were considerably relieved. At high water she was completely out of her bed. At the next low water I hove all the purchases down again. At half flood she floated; and the whole group drove together into the harbour, a distance of three miles, and grounded the frigate on the west side of it. It took me two tides more to lift her on the shore, sufficiently high to pump her out; which was then done with ease, and the ship completely recovered, without the smallest damage whatever, either to her bottom or her sides.

I do

I do not apprehend there is any thing new in the mode I adopted in weighing the Ambuscade, excepting the idea of removing the effect of cohesion, by the process before described; and I have every reason to think, that if that principle had been acted on in the attempt made to weigh the Royal George it would have succeeded.

On the Advantages of Mr. Boswell's *Patent Method of constructing Ships.*

Communicated by the Inventor, in a Letter to the Editors.

Gentlemen,

I HAVE at length the pleasure to inform you, that I have compleated the arduous undertaking which I commenced shortly after I last saw you.

Those alone who have experienced the trouble of having new ideas put in execution on a large scale, can conceive what it is to have to struggle with ignorance, insolence, illiberality, and injustice in all its varied forms, from open pilfering to artful over-reaching deception, in addition to the usual difficulties. And the delay which naturally attends the first construction of any thing, having been studiously increased by the artifice of those I had the ill fortune to employ, has protracted this scene of contest so long, that it is only at the termination of the second year from the passing of my patent that I have been able, with the most strenuous exertions, to produce the first specimen of my method of constructing ships for which it was obtained.

The ship Economy, of London, 200 tons measurement, built on this plan, is now moored opposite the Union Stairs, where she will lie some time for the inspection of those

[redacted]

those who have an interest in constructing large vessels in the cheapest and strongest manner ever yet laid before the public.

The plan adopted in the formation of this ship is the third mentioned in my specification, and the one designed for large vessels, of 500 tons and upwards.

As my specification, published in your Repertory *, may not be in the hands of all those who see this paper, I will add a short description of the ship.

Its external appearance is nearly the same as that of any other vessel of the size, and the outward planking done in the usual manner. It is the internal construction alone to which the patent relates, and that is as follows:

The best general idea of it will be obtained, by conceiving a vessel built with timbers, or ribs, much smaller than usual, with an internal framing, so contrived as to give every requisite support and strength both to them and the entire vessel, with the least timber, and of the cheapest form, and without any knee-timber.

The floor-timbers are molded seven inches, and sided six: these, with four futtocks and two top timbers at each side, form what is called a frame of timbers. Those small timbers are laid down so that their terminations all fall out in fair lines, which are nearly the same as the ribband lines, when below the wales. Along those lines inside are laid fore and aft ribs, from stem to stern post, so as to support the extremity of every one of the small ribs in the ship. The fore and aft ribs are six in number at each side; one directly under the water ways, another at the level of the lower beams, and the other four placed nearly at equal distances between these last and the kelson: each pair uniting in a breast-hook at the stem.

* See vol. II. Second Series, p. 81.

The

The pieces of timber which form these fore and aft ribs are scarfed at their extremities with hook scarfs, and so placed that the scarfs fall out in fair vertical sections of the ship, where they are supported, and firmly bolted to transverse framings, contrived so as to unite the greatest strength with the least obstruction, and which are five in number in the whole ship.

Those transverse framings last mentioned must be considered as the great support of the vessel, and the foundations, as it were, on which all the other parts rest, as the beams of a wooden bridge are supported by the piers. (I mention this, because some who pretended to understand the plan have absurdly proposed their removal.) Those transverse framings are each formed by one upper and one lower beam, two pair of futtocks, a floor timber, two pair of top timbers, and four bracing pieces; the whole connected into one firm framing, self-supported, independent of any other part. Some, from the similarity of the sides of these frames to riders, have not hesitated to pronounce them such: but to a candid observer the whole of this distinct self-supported framing will be obvious, and evidently such as has been used in no other vessel hitherto.

The four bracing pieces form each framing into a set of triangular compartments: which triangular framing gives the greatest stability possible, as a triangular frame cannot be made to give in, or alter its figure, by any force which is not sufficient to tear its connecting parts through the timber of which it is composed; a property which no other figure possesses.

These transverse framings (besides supporting the fore and aft ribs, and by them the small vertical timbers) tie and unite the vessel together, across ship, so as to give much greater strength than hanging-knees, whose place they supply, at a much cheaper rate.

The

The framing of the deck is also divided into triangular compartments, as specified in my patent, so as to preclude the use of lodging-knees entirely; which compartments are formed by six pieces of timber, which proceed obliquely at each side, from the top of each beam to the fore and aft rib next adjoining, into which they are dovetailed and bolted; long carlings from beam to beam, at each side of the hatchways, with these pieces, support small ledges, on which the deck is laid in the usual manner.

The vessel in coming round from Southampton water sailed remarkably fast, and stayed and steered admirably well.

Advantages of this Method of framing Ships.

1st. Timber of less than one fourth of the usual girth can be used, in this method, in constructing large vessels, for nearly four-fifths of their frames.

This will be a direct saving in the difference of price of small timber and large for the quantity used; for large vessels this will be considerable, and, according to the present contract prices for naval timber, not less than from two to four pounds per load. Besides this, it is a great national benefit in another point; for, by this means, timber of half the number of years growth, or less, can be used for naval purposes; and thus forty or fifty years, or even less, be sufficient to produce timber fit for the navy, instead of the vast period of near a century, now necessary; by which the land will not only produce a double crop in the same time, fit for this purpose, but all danger be removed of there being a stoppage of building, for want of a supply of timber, at any future period; an event extremely probable to take place, from the increasing difficulty of getting the large kind used at present in the Royal Dock Yards.

2d. Much shorter timber may, in forming the futtocks, be used, without any danger of weakening the ship, on account of the great support given to them by the fore and aft ribs, and other internal framing, before described.

The advantage of this is, that it renders the compass timber for futtocks easier to be procured, and prevents any necessity of using any timber cut across the grain.

3d. The use of knees of every kind is superseded by this mode of building, as the triangular framing of the decks gives all the effect of lodging-knees, and that of the transverse frames more than supplies the support given by hanging-knees.

This would occasion a considerable saving in large vessels, on account of the great price of knee-timber fit for them; which, for that of 30 feet meeting, is near ten pound per load, and for the smallest kind, taken at the dock-yard, not less than 8*l.* 15*s.*

4th. Plank of half the usual thickness may be used for lining; the great support given by the fore and aft ribs rendering any use of inside plank, to strengthen the vessel, needless, and confining its purpose merely to prevent ballast, or other matters, from getting between the timbers, so as to rest on the outside plank.

This will also cause a saving of consequence in large vessels; plank of all kinds, but particularly that of great thickness, being the next dearest article to knee-timber.

5th. It is probable a much less quantity of timber might be used with safety in this method, on account of the great strength produced for the timber used. 1st. By the triangular framing. 2d. By every timber having a solid support at each extremity. 3d. By the increase of thickness from in to out all along the fore and aft ribs being very great in proportion to the timber used.

6th.

6th. It is probable, vessels built in this method will last many years longer before decay; because the use of small timber admits of a kind more spiny and durable than the large, which is often dotard, and never lasts so long; and also because this construction admits of a free circulation of air among the timbers, than which nothing is known to contribute so much to their preservation. It is moreover conceived, that the timbers being prevented from working by the solid support each has at its extremities, will cause the vessel to wear less, and at the same time render it safer, by diminishing the danger of starting planks, or otherwise causing bad leaks.

7th. The timber of considerable size used in this method is almost all nearly straight, or of very little curvature, on account of its running fore and aft.

This kind is much easier to procure than large compass timber.

8th. Short-top timber and coarse butts can be worked up to advantage, instead of being sold for less than half cost, or burned; as this kind will do sufficiently well for the number of short ledges in the deck frames, and to support the lining at the floor, which are wanted in this mode of building.

9th. Vessels built in this manner will not be so liable as others to hog, or have their backs broken, on account of the great strength length-ways, caused by the fore and aft ribs.

10th. Vessels so built will be drier, from the circulation of air before mentioned, and having the floor-lining detached from the timbers; which quality renders this construction particularly valuable for the ships used in the East and West India trade.

The advantages above recited relate to vessels entirely formed in this manner. It should be known also, that

 parts

parts of this plan may be applied with profit. The mode of framing the decks, for instance, might be used to save lodging-knees in vessels built in other respects in the usual mode. Other parts of it might be applied to the strengthening old vessels, which, by this means, might be made to last many years, after they would otherwise have been unserviceable.

The principles of this method of building are capable of being extended still further than they are in the vessel here described: the triangular framing may be even adopted to the construction of fore and aft ribs, so that I could have them constructed also of small timber, if required. Thus, by this means, the former barrier to the increase of size in ships is removed, as it no longer now depends on the size of timber; and ships of any dimensions required may be formed, of any strength requisite, of small timber.

Before concluding this paper, I take the opportunity to offer to notice another matter of some consequence, though in an inferior degree; which is a capstan that I have contrived, so as to deliver off the messenger as fast as it receives it, without requiring to stop, to raise, or shift the messenger; and this it performs without any of the complicated means used in most other methods for the same purpose, or occasioning any additional friction, which most hitherto made public do. It is also so easily formed, that any good shipwright could make it.

I also beg leave to caution the public against some patents taken out since the date of mine, particularly one a full year after, which directs the use of diagonal ledges in the framing of decks, and which, in other respects, seems to be an intended imitation of my patent. Now as one of the chief parts of my invention consists

in

in the use of triangular framing in the deck-framing and elsewhere; and as it is an utter impossibility to use diagonal pieces in frame-work without producing triangles, I leave every one to judge of the risk that will be run in adopting such evident infringements of my right.

Any farther information relative to the advantages to be expected from my patent method of constructing large ships from small timber, I will give with pleasure to any who have serious motives for the enquiry, or answer post-paid letters, directed to No. 9, George's-street, Minories, where I am now ready to receive proposals for superintending the construction of other vessels on the same plan.

I am, Gentlemen,

Your very humble servant,

J. W. BOSWELL.

Description of a self-acting Water-Closet; invented by T. W. *Esq. of Batheaston, and communicated by Mr.* BENJAMIN HOOKE, *Optician, Fleet-street.*

With an Engraving.

A, Fig. 5, Plate XVI. the reservoir.

B, a copper or leaden cylinder, having an inverted valve at the top, and an upright valve at the bottom, which are connected with each other, and to the end of the lever C, by a wire or chain. The cylinder is terminated at each end by brass flanches, which unite it to the parts fixed above and below by screws; by removing which the cylinders may be detached, and the valves new-leathered, &c.

D, the seat of the closet, fixed at one extremity by hinges, and having a wire or chain fixed to the other extremity

extremity against the side wall, which passes through the pipe E (soldered into the reservoir), over the wheel or crank F, to the lever at G.

I, the weight or counterpoise, of about three or four pounds.

K, the basin, communicating with the cylinder B at the side, and the stink-trap L and soil-pipe M beneath.

N, an air-pipe, leading from the cylinder to the open air.

O, a male and female screw, fitted to the wire by swivels, to regulate its length.

The Operation.

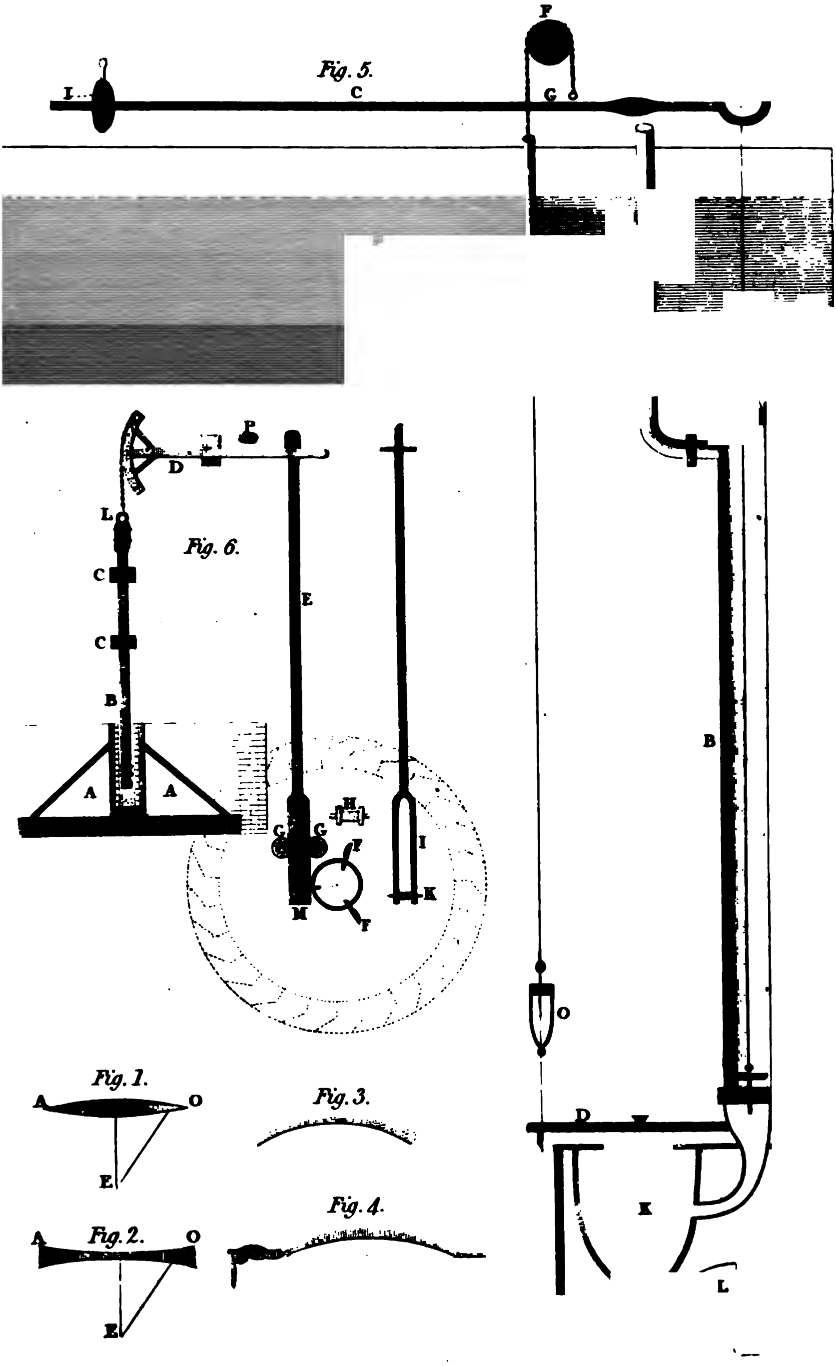
The counterpoise operating powerfully on the upper valve prevents the escape of any water from the reservoir into the cylinder; but on a person sitting down, the seat D is depressed about an inch, when the wire or chain, passing over the wheel to the lever at G, raises the counterpoise, and opens the upper inverted valve, and closes the lower one, which prevents the water that rushes into the cylinder from making its escape into the basin. But on the person's rising from the seat, the counterpoise again closes the upper valve, and permits the contents of the cylinder to rush into the basin by the opening of the lower valve.

N. B. The air-pipe N is soldered into the reservoir, and united to the cylinder by a swivel-screw. It should be made at least of inch-pipe, to admit air sufficient to enable the water to escape with its full force.

The basin should not be of the kind which admits the water obliquely, and gives it a circular motion, as in this case the water, being checked, has not sufficient force to drive the soil clear of the basin.

New

Pl. XVI. Vol. IV. Second Series.



New Process for preparing the Muriates of Barytes and of Strontian.

By M. Bouillon la Grange.

From the Annales de Chimie.

THE decomposition of the hydrogenated sulphuret of barytes by the muriatic acid, is the means most generally employed in the laboratories for obtaining the muriate of barytes. Several chemists have announced *, that all the sulphates, excepting that of lime, are decomposed by the calcareous muriate, but they have not bestowed particular attention upon this kind of decompositions. However, I have just been informed by Cit. Vauquelin, that in the year 7 Citizens Pelouze and d'Aracq had effectuated this decomposition in the laboratory of *Ecole des Minés*. Lately also, Cit. Julia, corresponding member of the Society of Practical Medicine at Montpellier, has told me that he, together with M. Figuier, in the year 10, likewise obtained the decomposition of the sulphate of barytes by the calcareous muriate; but nothing has yet been published upon this subject. It was therefore necessary to establish, by experiments, not only a regular process for the preparation of the muriate of barytes, but also to make the application of the same process to that of the muriate of strontian. It is the more interesting to determine the state of purity in which the muriate of barytes thus obtained exists, because it has been applied to some useful purposes in medicine, as I shall shew hereafter. It was also necessary, in order to consider this

* See *Essai de statique Chimique, par le Cit. Berthollet*; *Systeme de connoisances Chimiques, par le Cit. Fourcroy*. Tom. III. p. 194; and my *Manuel de Chimie*, third edition, vol. I. p. 562.

new

new preparation in an economical point of view, to place it in comparison with the process most generally used.

The following is the most accurate method of effecting the decomposition of the muriate of barytes.

Preliminary Operations.

1. We procure muriate of lime by dissolving, in a small quantity of hot water, the residue of the decomposition of the muriate of ammoniac by lime; we thus separate the calcareous muriate from the excess of lime which always attends it, and which even becomes detrimental to the operation; we then evaporate the filtrated liquor to dryness.

2. We reduce the sulphate of barytes to powder, and pass it through a sieve.

Process.

A. After having mixed equal parts of calcareous muriate and of sulphate of barytes together, we throw the mixture by spoonfuls into a crucible, previously heated to redness. The matter becomes a little inflated, and afterwards passes into fusion. We successively add the remainder of the mixture, and keep up an equal temperature till the whole is liquified; as soon as the fusion is tranquil, we remove the crucible from the fire, and pour out its contents upon a casting slab, which must previously be heated. Without this precaution the matter in becoming solid breaks with an explosion, and is projected with great force; the pieces even carry away with them fragments of the stone to which they strongly adhere.

The matter thus cast breaks as it cools, has a whitish grey, sometimes a darker grey colour, according to the length of time that it has been kept in fusion. It is very hard,

hard, sonorous, and attracts the humidity of the atmosphere.

B. It is reduced to powder, made to boil some minutes in a small quantity of water, about six times its weight of distilled water, and filtrated.

Upon the insoluble part we pour a less quantity of boiling water, and unite the liquors.

We then evaporate to two-thirds in a well-tinned copper basin, and terminate the evaporation either in a capsule of *hygio-cerame* or of porcelain, or in one of glass or earthen-ware, placed in the sand-bath. We stop the evaporation as soon as we observe a pellicle upon the surface of the liquid. We then remove the capsule from the fire, and we obtain, by cooling, very beautiful and shining crystals, the brilliant whiteness of which distinguishes them from those obtained by the old process.

C. We evaporate the decanted liquor, and obtain a second crystallization; this affords only very small crystals, which acquire a little humidity in the air.

D. As it was wished entirely to separate the muriate of barytes, this second decanted liquor was evaporated to a strong pellicle, it was left to cool, and there was precipitated a white matter, without a regular form, which, when dried, attracted the humidity of the atmosphere more readily than the crystals obtained in experiment C.

E. Finally, the supernatant liquor was condensed to dryness, and it afforded perfectly pure muriate of lime.

The last crystallization had carried away all the muriate of barytes that might be in solution in the decanted liquor, experiment D, so that I could not discover its presence.

These first experiments not having afforded perfectly pure muriate of barytes, I resumed each of the above crys-

crystallizations, in order to separate the calcareous muriate from them.

The first crystallization, experiment B, contained 0,425 grammes, or eight grains in the ounce, of calcareous muriate.

The second crystallization, experiment C, 0,956 grammes, or 18 grains.

The third crystallization, experiment D, gave 2,388 grammes, or 45 grains of calcareous muriate in the ounce.

These results prove that the muriate of barytes, in order to be entirely freed from the calcareous muriate, as it ought to be for the purposes of analysis, requires to be subjected to a second crystallization; and then we obtain the salt in great purity. It is likewise a necessary precaution, after having decanted the supernatant liquor, to pour a small quantity of cold distilled water upon them, in order to carry off the last portions of the liquid that adheres to them; when this was not done, I have found that there always remained a small portion of calcareous muriate. For medical purposes, however, it may be employed without washing.

Muriate of Barytes obtained by the Decomposition of the Sulphuret of Barytes with the Aid of the Muriatic Acid.

In order to appreciate the advantages of the new process, I have compared them with the products afforded by the ancient one.

I have found that the sulphate of barytes, mixed with charcoal and kneaded with a little oil, was but imperfectly decomposed at the temperature of our reverberatory furnaces, which is the process most commonly employed, but if with the aid of a bellows, we keep up a white

white heat, then a larger quantity of sulphate is decomposed.

If we now consider the operation in itself, we shall not hesitate to give the preference to the new process.

We shall perceive, 1, that it requires much less time and combustibles, for ten minutes are sufficient to obtain a perfect fusion, whereas the old process requires that the fire be kept up three or four hours; 2, that there is a saving in the employment of the muriatic acid, and less manipulation required, as this acid exists in the calcareous muriate; 3, that the muriate of barytes is much more pure, even at the first crystallization, whereas we are obliged to subject the other to several operations, in order to have it of the same degree of purity. It is of the greater importance to have it thus, because, for the purposes of medicine, it is requisite that it should be freed from all foreign, and especially metallic, matter.

The muriate of barytes has for a long time past been considered as a very valuable re-agent for analysis, and indicated in scrophulous disorders. In general, the German physicians employ it with much success, especially since Mr. Hufeland, first physician to the king of Prussia, has shewn the great advantages to be derived from its use. Mr. Hufeland has administered it against scrophulous diseases, the goitre, affections of the eyes, the itch, tetters, &c. The manner in which this muriate is to be taken, according to a German writer on pharmacy, is the following:

A drachm of this salt is dissolved in two ounces of any distilled water, such as that of balm, of strawberries, or any other, to which is added half an ounce of syrup of orange-peel, of cherries, &c. For an adult, the dose is

from 40 to 60 drops of this liquor, four times a day, in a glass full of ptisan of sarsaparilla or dulcamara.

In other cases it is administered with extract of opium, or also this salt is dissolved in distilled water, and extract of cicuta or hyoscyamus added, especially in affections of the eyes.

The dose may be increased according to the state or the strength of the patient.

Of the Muriate of Strontian.

The experiments which I have just related naturally led me to examine the action of the calcareous muriate upon the sulphate of strontian.

The decomposition of this salt is more difficult to be effected than that of the sulphate of barytes, and it becomes still more so if we do not previously take care to separate the oxide of iron and the earthy matters which are found mixed with it; however we may dispense with this, if we wish to save the acid which this preliminary operation requires. The two processes which I am about to describe, have perfectly succeeded with me.

The first consists in reducing the sulphate of strontian* to powder, and passing it through a sieve; it is then wetted with muriatic acid, which seizes upon the lime and the oxide of iron; it is left to macerate for some time, the liquid is poured off, and the insoluble residuum is carefully washed.

When the matter is perfectly dry, it is mixed with a weight equal to its own of calcareous muriate, and in the remainder of the operation we proceed as has been said above with respect to the barytes.

* These experiments were made upon sulphate of strontian from the environs of Paris.

The

The only differences in the manipulation are: 1, that the mixture is fused with greater difficulty, and that we obtain only a paste-like mass at a red heat, whereas when we employ a forge-bellows, we have in a very short time a complete fusion; 2, that the liquor must not be evaporated to a pellicle, for this produces a saline mass or confused crystals, mixed with a large quantity of muriate of lime, but it must be tried by taking out some drops and letting them cool in a vessel; if crystals are formed, we have the proper degree of evaporation. In this manner I have obtained a very fine crystallization, superior in whiteness and purity to that which is obtained by following the old process, and which hardly contained any calcareous muriate. This difference in its manner of crystallizing proves that the muriate of strontian is much more soluble in hot than in cold water; consequently it crystallizes by cooling. The muriate of barytes, on the contrary, is almost equally soluble in cold and hot water, and crystallizes by evaporation; an ounce of distilled water at a temperature of 70 degrees, dissolves nine drachms and fifty grains of muriate of strontian; the same quantity of water, at the same temperature, dissolves only three drachms thirty-five grains of muriate of barytes. The evaporation must therefore not be carried to the degree designated by the word *pellicle* *. Besides, the

* This observation ought to prove how advantageous it would be to banish this expression from practical chemistry, and to substitute areometrical degrees in the place of this uncertain method of operation. I have already indicated, in my *Manual of Chemistry*, the result of experiments which I have made relative to this subject, upon several saline substances. I have not yet had leisure to pursue them upon other salts. See the articles *sulfates de potasse, de soude, de magnesie, acides d'alumine*; *nitrate de potasse*; *muriate d'etain, acetate de plomb*; *sulfates de cuivre, de fer*; *tartrite de potasse, &c.*

the more we evaporate, the more calcareous muriate is carried into the crystallization of the muriate of strontian. Upon the whole too much attention cannot be bestowed upon it, for there is some difficulty in hitting the proper degree.

The first crystallization contained only ninety-one grammes of calcareous muriate.

A second was sufficient entirely to deprive it of that substance.

We may also, as I have already observed, prepare this muriate without previously washing the sulphate of strontian with an acid.

For this purpose, we take equal parts of sulphate and of calcareous muriate, reduced to powder, introduce the mixture by spoonfulls into a crucible which we keep at a red heat for the space of a quarter of an hour. This operation requires the application of a more intense degree of heat than the preceding. When the matter is completely fused, we pour it upon a marble or a casting-slab.

It is hard, and differs from that obtained by the first process in being of a blackish colour, whereas the other is of a greyish white.

This substance is reduced to powder; it is boiled in four times its weight of water, and filtrated; afterwards the liquor is exposed to a gentle heat with the contact of the air; it soon becomes turbid and milky, a phenomenon which proceeds from the lime which has been rendered caustic during the operation, returning into the state of carbonate. It is evident that it is of essential utility thus to suffer the lime to absorb carbonic acid again, because, with the acid of this means, we may separate a very large quantity of it. The liquor is filtrated and evaporated to dryness; a new solution is made

in

in distilled water: the carbonate of lime is precipitated, and we then obtain, by evaporation, the muriate of strontian, which we may cause to crystallize a second time, in order to deprive it of the calcareous muriate.

The quantity of muriate which this operation yields is very near the same with that obtained by the first process.

If we compare the quantities of muriate of strontian obtained, with those resulting from the new process, we shall perceive the decomposition of the sulphate of strontian is not performed without difficulty, especially at the temperature which our reverberatory furnaces afford; whereas, by the means which I propose, a greater quantity of sulphate is decomposed.

I shall not dwell upon the advantages of these processes; had they no others than those of the saving of time and combustibles, of finding the muriatic acid in a residuum of little value, and, finally, of avoiding the disengagement of that fetid and deleterious gas, they would be sufficient to give them a claim to be preferred by chemists.

It is known that the sulphurated hydrogen gas, which proceeds from the decomposition of the sulphurets of barytes and strontian, although it has not yet been analyzed, however distinguishes itself from that which is disengaged from the sulphurets of potash or of soda. Of this Cit. Vauquelin had a melancholy proof, when he was thrown into asphyxia by sulphurated hydrogen gas, which proceeded from the decomposition of the sulphuret of barytes by an acid. Certainly the consequences of this asphyxia are not the same as those which proceed from other elastic fluids; they are much more protracted, more exhausting, and terminating in tremors of all the

lower

lower part of the body, which indicates a much more deleterious property.

Experiments have shewn, that whenever we pour an acid upon the sulphuret diluted with water the sulphurated hydrogen dissolves barytes or strontian. These substances exist in it in a greater or less quantity, according to the agitation which we are obliged to employ in order to facilitate the action of the acid; when we pour it without stirring, the hydrogen gas hardly dissolves any at all. The presence of the strontian is easily discovered; nothing more being necessary than to agitate and inflame the gas which is disengaged at the moment when the acid is added. It burns with a flame of a very distinct purple cast.

With regard to the action of several nitrates upon the sulphate of barytes, I have not yet obtained satisfactory results. In my opinion it would be difficult to decompose the sulphate of barytes by these means. The temperature which we are obliged to employ is insufficient to fuse the sulphate; if we augment it, the nitric acid is decomposed. The difference of weight also becomes very prejudicial to the success of the operation. The sulphate of barytes separates from the nitrate, and remains at the bottom of the crucible in a paste-like state, whilst the nitrate of potash swims above it; and however we may stir them, the separation takes place as soon as the matter is poured out.

The nitrate of potash is that which resists the action of fire the most; the nitrate of lime, that which is the most speedily decomposed.

Extract

On the Preparation of a Blue Colour from Cobalt, as fine as Ultramarine. By M. THENARD.

From the BULLETIN DES SCIENCES.

M. THENARD, who had been directed by the Minister of the Interior, to make a series of experiments upon the colours necessary in painting, occupied himself first with seeking for a blue that might be a substitute for ultramarine: a very simple idea led him to the solution of this problem. Having observed that the fine blue which adorns the vessels of the manufacture of Sèvres, had the arseniate of cobalt for its base, he thought that by making an accurate mixture of this salt, and of alumine recently precipitated, the same result might perhaps be attained, without operating the fusion of the matter. He made the experiment; it succeeded completely; and it succeeded equally with the phosphate of cobalt. Among the salifiable bases there is none that can be substituted in the place of alumine; every other produces only brown or black colours, or a more or less deep violet. The same is the case with the salts of cobalt; none can supply the place of the arseniate and the phosphate; and the latter has even advantages over the former which entitle it to the preference. The best proportions are: for the blue with a base of arseniate, one part of arseniate, and one part and a half or two parts of alumine; and for the blue with a base of phospate, one part of phosphate, and one and a half, two, or three parts of alumine. With less alumine we obtain violet or green hues; with more, we have blue colours, but less deep. Those of the arseniates are always less vivid and intense than those of the phosphates, and those of the phosphates themselves are a little less so than the ultramarine, which

sells at 100 francs the ounce. It is also evident that the degree of heat applied must have a considerable influence upon the tint which the colour acquires; it ought always to be some degrees more intense than the cherry-red. In general we may be almost certain of obtaining that which is proper for the operation, if from time to time we take the matter out of the crucible, and examine the tint which it has acquired.

The manner of preparing the arseniate and the phosphate of cobalt, has not less influence than the temperature upon the results of the experiment. It is impossible to separate too carefully the iron which the ore of cobalt always contains. Its presence would be very injurious to the purity of the colour.

In order to make the arseniate of cobalt with this ore, which the author supposes to be composed, like that of Tunnaberg, which he used, of sulphur, arsenic, iron, and cobalt, we change it, by means of the nitric acid, into sulphuric acid and arseniate of iron and of cobalt. After having evaporated the liquor, in order to disengage the excess of nitric acid, we dilute it with water, and gradually add to it a weak solution of potash, which separates from it all the arseniate of iron in the form of white flakes; then by filtrating, and again adding solution of potash, we obtain a fine rose-coloured precipitate, which is the arseniate of cobalt. An excess of alkali must not be used; for the precipitate would thereby be in part decomposed; it would become blue, and no longer fit for answering the purpose intended. From any other ore of cobalt we might, by similar or little different means, obtain the arseniate of cobalt.

In the preparation of the phosphate of cobalt we must follow another process: we first roast the ore till no more arsenical vapours are disengaged from it, notwithstanding that

that an intense degree of heat is kept up for a long time; afterwards we treat it by the nitric acid; the iron passes into the state of red oxyd, and does not dissolve; we separate it by filtration; then we condense the liquor, in order to separate the acid that is not in real combination, and now, by diluting it with water, and pouring upon it phosphate of soda, we form phosphate of cobalt, which deposites itself in the form of flakes of a deep violet colour. One part of ore affords half a part of phosphate of cobalt; we also obtain from it the same proportion of arseniate; whence we may easily estimate the price of the blue, with the base either of arseniate or of phosphate. Supposing it to contain the smallest of the quantities of alumine that have been specified, it will not cost the person who makes it more than 40 sols the ounce.

These results, though satisfactory, leave still many points to be ascertained; they would have been in a manner useless, if these colours, beautiful in appearance, had not been of a perfect blue, and if, with facility of use, they had not combined the property of being unalterable.

Messrs. Vincent and Merimée have made a great number of experiments upon them, both with gum and with oil; they have all succeeded beyond their expectations: they differ so little from the comparative ones made with ultramarine of the best quality, that the artists themselves cannot distinguish them from one another. After having been exposed for three months to the light, they had not undergone the slightest alteration; and as their colour, in this state of purity, resists the action of the most powerful reagents which chemistry possesses, that of the oxygenated muriatic, and of all the other acids, it is probable that it will prove as permanent as that of ultramarine itself.

Simple and constant Process for obtaining the Colour, known by the Name of Turkey or Adrianople Red, in its greatest Beauty and Solidity. By M. HAUSSMANN.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

AFTER having made a caustic ley with good potash of commerce, dissolved in four parts of boiling water, and half a part of quick-lime which is afterwards extinguished in it, we dissolve one part of pulverized alum in two parts of boiling water, and whilst this latter solution is still hot, we successively pour into it, during continual stirring, the above-mentioned ley of caustic potash, till the alumine, which it had at first precipitated after the saturation of the excess of sulphuric acid, has been re-dissolved. We then let this solution of alumine stand quiet, after which we decant it and mix with it $\frac{1}{15}$ of linseed-oil, with which the alkaline solution of alumine forms a milky liquid. As the oil gradually separates from this mixture under the appearance of cream, it must not be used without stirring it anew. The skains of cotton or flax must be successively steeped in it and pressed out equally, after which they are hung to dry upon a pole, in the order in which they have been taken out of the mixture. We may dry them in a place sheltered from the rain in the summer, and in winter in a place artificially heated, and let them alone for twenty-four hours. We wash them in a very clean running stream, dry them again, afterwards steep them in the alkaline ley; wring them out and dry them a second time in the same manner as at first, taking care to begin the immersion into the ley with the skains which have been passed the last through the oily mixture, because the first always carry away a larger portion of oil than the last. It will also be very

very proper every time to consume the mixture, in order that it may not have time to attract the carbonic acid of the atmosphere; for the alkali, by returning into the state of carbonate, causes the alum to be precipitated, and acquires the property of mixing with oil.

Two impregnations of the alkaline solution of alum mixed with linseed-oil are sufficient for obtaining a fine red; but if we continue to impregnate the skains a third time and even a fourth, under the same circumstances as the first, we shall obtain extremely brilliant colours.

The intensity of the red colour which we intend to obtain, will be proportionate to the quantity of madder which we employ in the dyeing. If we take a weight of madder equal to that of the skains, we shall produce a red which the freshening operation will convert into a rose-colour; on the contrary we shall obtain more or less lively carmine tints by employing two or three, or even four parts of madder, never neglecting to add a little chalk, if the waters which we use do not contain it. Four parts of madder will produce a red of such beauty and intensity, that it could not be introduced into commercial circulation, because it would not be paid sufficiently dear.

By making the oily alkaline solution of alumine with two or three parts of water, and impregnating the skains with it twice or thrice, or even four times, in the manner above-mentioned, we shall obtain light tints, without employing much madder, but they will not have the same intensity with those that are procured by means of the same solution concentrated, and an equally small quantity of madder.

The best manner of obtaining tints light and vivid at the same time, would be to expose the deep and freshened reds for a sufficient length of time to the action of the

the ley of oxygenated muriate of potash or of soda, with excess of alkaline carbonate, to have that degree of tint that might be required, but it is very evident that this method would be more expensive.

In order to have the oily alkaline solution of alumine always nearly of the same degree of concentration, we must employ an areometer to determine the degree of strength of the caustic ley, before we employ it for the process of the solution of the alumine. This caustic ley should be made with the best potash of commerce that could be procured, and we should note the degree which it indicated by the areometer, in order that if we afterwards employed potash of an inferior quality, we might be able, by evaporation, to bring the ley obtained to the requisite degree of strength.

Caustic ley made with four parts of good potash of commerce cannot contain much of foreign salts. In making it in the large way, and after having decanted the limpid part of it, it will be necessary to stir the matter that is deposited twice every day for some time, in order that we may be able to decant from it the rest of the alkaline liquor; and in order to lose nothing of what is left in the deposit, it will be necessary to dilute it with a fresh quantity of water, which we may employ afterwards for leying the cotton, which, before it is dyed, must be well purified and cleaned. As the squeezing out with the hands might derange the threads of the cotton or flaxen skains, and consequently weaken them, it will be proper, when we operate in the large way, to squeeze them out by means of a press.

With respect to flaxen thread which we intend to dye a fine deep and permanent red colour, it will be necessary previously to bleach and impregnate it at least four successive

successive times with the oily alkaline solution of alumine, not only because alumine and the metallic oxyds do not adhere so readily to flax as to cotton, but also because these mineral substances, being coloured, more easily quit the flax than the cotton in freshening.

As to the dyeing of thread, of cotton, and of flax, sufficiently charged with alumine by the oily alkaline solution of this earth, it is necessary first to free the skains from all saline substance, as well as from superfluous oil, by rinsing them a long time in very clean running water, after which we must dispose them, without drying them, upon an apparatus which we must invent ourselves according to the form of the cauldron in which it is to be placed, in such a manner that during the dyeing we may be able continually to stir and turn the skains, in order that they may seize the colouring particles in an uniform manner, and in all their parts.

The bath is to be composed of madder, to which a sixth part of pulverized chalk is added, and which is diluted with nearly thirty or forty parts of water. The heat must not be carried to a greater degree than that at which the hand cannot be held in the bath without scalding it, and this degree must be kept up nearly two hours. Three hours are sufficient for exhausting the madder. After the skains have been taken out of the bath, they must be washed with a large quantity of water in order to clear them, and then subjected to the refreshing operation, which consists in boiling them a sufficient length of time in water containing bran inclosed in a jar, and adding soap and alkaline carbonate, in order to give the red a rose or crimson tint.

Account

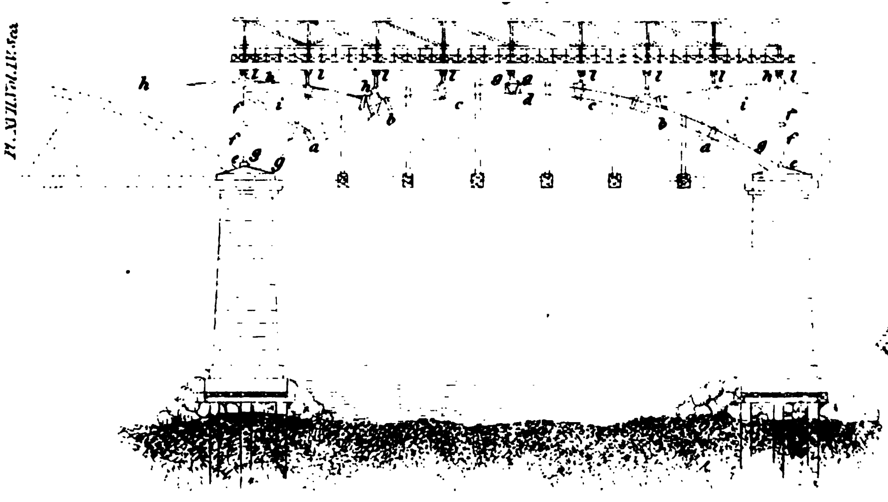
Account of the Bridge which is constructing at Paris between the Louvre and the Hotel de Quatre Nations, and of the Experiments made to ascertain its Stability.

From the Bulletin des Sciences.

With a Plate.

THE bridge of the Louvre will be the first in France in which the arches have been made of iron, or rather of cast-iron. It is even the first which has been executed in Europe according to the system adopted in its construction; and this system has the advantage of greatly economizing the metal, in comparison with that used in England for iron bridges. In fact, in that of Coalbrook Dale, on the Severn, constructed about twenty-four years ago, and which consists of a single arch, 100 feet in span, and 25 feet wide between the railings, the weight of metal that has been employed amounts to 757,000 lbs.; whereas the weight of cast metal for the nine arches of the bridge of the Louvre, will not amount to 600,000 lbs.; whilst its length between the abutments, is 516 feet, and its width between the railings, 30 feet. It is true the English bridge serves for carriages to pass over, whilst that of the Louvre is intended only for foot-passengers. However, it has been ascertained, by the experiments which have been made, that by augmenting either the number of ribs, or the dimensions of the pieces of which they are composed, it would by no means have required so much metal, though it be five times as long as the Coalbrook Dale bridge, and wider than it in the proportion of 100 : 74. The bridge of the Louvre (See Plate XVII. Figs. 1, 2, 3.) consists of nine arches, and each arch is formed of five ribs. (See Fig. 1.) To each rib there are two pillars *f f*, *f f*, implanted into beds of cast metal, fastened to the piers; a large arch *g g*, *g g*, consisting of two pieces, which join in

Pl. XVII. Vol. IV. Sec.



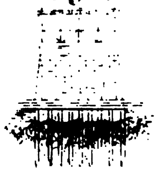


Fig. 4.

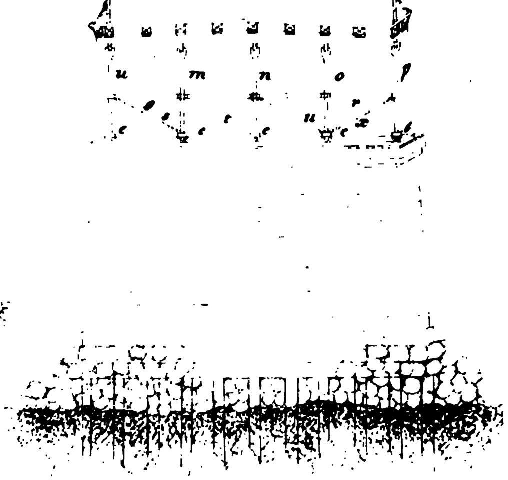


Fig. 3.

1 2 3 4 5 6 7 8 9 10 11 12 Metres

1 2 3 4 5 6 Toises

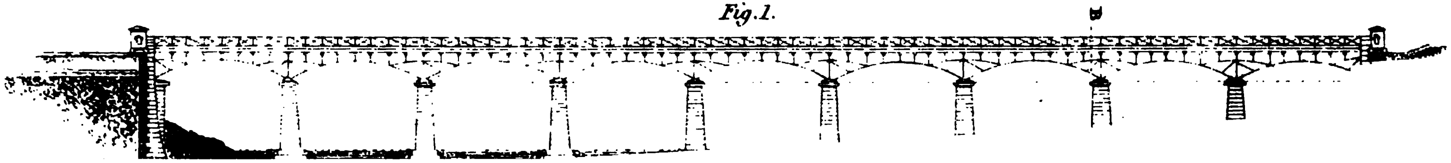


Fig. 1.

in the middle; two small arches *h h, h h;* two spurs *i, i*, and eight supports *l, l.* The five ribs are joined together by braces at *a b c d, c b a*, and others between these; and the upright bars *u m n o p* are joined together by the brace *g r*, and the spurs *s t u x*.

The metal pieces of which this bridge is constructed, are cast near Touroude, in the Department of the Orne.

M. Dillon superintended the construction of this bridge, and made the experiments of which we are about to give an account.

A rib of the bridge, taken at a venture, had been fixed upon a frame of wood-work so joined together in parts, that it could not sensibly lengthen; to it were adapted cast-iron beds similar to those fixed upon the piers, and upright bars, with forked tops, in order to prevent the rib from deviating from it perpendicularly during its being loaded, and also to support it in case of its breaking, and seven boxes suspended at the same points where every rib will experience the pressure of a part of the flooring, and of the persons who shall pass over the bridge.

The boxes were filled at the same time, till they contained double the weight which each rib must bear under the supposition of an extraordinary concourse of people upon the bridge; and during this operation, attention was paid to the changes of figure which took place in the great arch *g g*: it successively sunk at the key or summit *d*, and rose towards the haunches *b b*, as every other body possessed of a slight degree of elasticity would have done, and it returned to its former position in proportion as the load was diminished.

These experiments therefore prove, 1st, that the system adopted has a degree of solidity more than what is necessary for the purpose for which it is intended, since the ribs upon which the experiments were tried, resisted

 a weight

a weight twice as great as that which they were required to bear, though deprived of the increase of resistance which they will require from the flooring, according to the manner in which it will be connected with them; 2d, that the cast metal, though sufficiently soft to be engraved upon and pierced cold, in order to obtain a regular and solid combination of the parts, has yet sufficient tenacity not sensibly to change its figure, nor to distort the symmetry of the forms.

Account of an improved Machine for stamping Ores. *By M.* DUHAMEL.

With an Engraving.

From the JOURNAL DES MINES.

WHOEVER has considered on the manufacturing of ores cannot be ignorant of the advantages which result from stamping stony substances, in which these minerals are found to exist. The machines employed in this operation have been in use a great length of time; they have been successively brought nearer to perfection, and are still susceptible of improvement.

Messrs. Daubisson and Lefroy have made some valuable remarks on this subject in former parts of this work. The principal object of the latter engineer is to make known the form and disposition of the cams fixed on the axis of the wheel, in order to raise the stampers vertically, without pushing them from, or drawing them towards, the axis of the wheel the least possible, with a view to diminish their friction against the guides; a friction which lessens the power, wears the stampers and the blocks between

tween which they play, and produces a considerable shaking and unsteadiness throughout the whole machine.

M. Lefroy was well aware that it would be impossible to avoid entirely the friction in question, while the cams on the axis of the wheel were left to act immediately under the arms of the stampers.

All the world allows that it is essential that the stampers should be raised by their centre of gravity, which will be the case in executing that which I am about to describe.

The following is a new method which I think will accomplish the desired object, and give action to the stampers without diverting them from their vertical situation, without producing shocks to the carpentry, or friction against the guides. It offers two other advantages.

First, the facility of enabling one to place the trough or battery of the stampers at a certain distance from the axis of the wheel, which will give room for the workmen, and for more conveniently placing the necessary utensils.

Secondly, the stamping-trough may be placed higher, so that the emptying of the water and the pounded minerals may be performed on a floor raised above the axis of the wheel. One may even fix this trough in such a way, that the upper part of it shall be on a level with the bottom of the canal which brings the water upon the wheel. By this means we have the advantage of its whole fall, which would facilitate the making of canals and labyrinths where the pounded minerals might be deposited. This matter is of the more importance since we frequently experience the want of room to place a sufficient quantity of cisterns, to receive the sands and the vessels filled with the metallic matters, of which a considerable part by carrying to a distance is lost.

To remedy these defects, I propose the mode of construction represented in the plate.

REFERENCE to Fig. 6, Plate XVI.

A A, section of the stamping trough or battery.

B, one of the stampers.

C C, guides to retain the stampers in a vertical position.

D, beam which by means of the chain L raises the stamper.

E, an iron-rod divided at the lower end to form a stirrup (I) to receive the cams F.

F, cams to raise the stampers, fastened to the axis of the wheel, the circumference of which is marked in dotted lines.

G G, two brass rollers which keep the stirrup in its vertical position.

H, one of these rollers seen lengthwise.

It will be perceived that by means of these rollers, the stirrup cannot be drawn towards, nor pushed from the cams, and that it is retained to its sides by the shoulders of the rollers.

Observations.

If the cams are of iron, it will be necessary to line the lower part of the stirrup M with a plate of brass, which will lessen the friction, or what is still better, fix a roller of that metal across the stirrup, as seen at K. In this case a little more length must be allowed to the stirrup.

When a longer or a shorter stroke is required to be made by the stamper, it is only necessary to fix the pivot which sustains the iron rod E into the upper or lower hole marked on the top of the rod.

In

In order that the weight of the rod shall not diminish the force of the stamper, it is essential that the weight of the sector of the beam D shall be sufficient to keep the rod in equilibrium. One may, according to circumstances, place the centre of motion of the beam nearer to the rod E, so as to obtain this equilibrium. It must be observed, however, that in this case the impulse which will be given to the beam, by the fall of the stamper, may raise the stirrup too high to be seized by the cams in its most convenient position. This inconvenience may notwithstanding be avoided, by fixing a flexible pole (as shewn at P) above the beam, against which it will strike.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

The Cow-Pox, a Preventive of the Rot in Sheep.

THE benefits of the cow-pox to the human species are no longer called in question; they are universally acknowledged, while the examples of the real advantages of vaccination in sheep, attest its efficacy in preserving them from the destructive disease the rot.

An experiment of this kind was lately made near Lyons, on the domain of M. Flandres d'Espinay, who possessed two flocks which were kept separate, one of Merinos and the other of the ordinary French breed. That gentleman resolved to try the effect of vaccination in preserving his fine-woolled sheep from the ravages of the scab which prevailed in his neighbourhood, and had already extended its pernicious influence to his flock of the

common

common breed. In this pressing danger he applied to the Veterinary School at Lyons, for intelligent pupils to inoculate his sheep of the pure breed with vaccine matter. The whole flock of Merinos was accordingly submitted to vaccination, which produced its effect in the usual time, and preserved the flock in the midst of the contagion without any other precaution.

Not satisfied with this result, M. d'Espinay placed forty of the sheep which had undergone the operation among the infected flock; but, though thus subjected to the influence of the disease, they withstood its attacks, while not one of those which had not been vaccinated escaped.

Use of Garlic against Moles.

Moles are such enemies to the smell of garlic, that, in order to get rid of these troublesome and destructive guests, it is sufficient to introduce a few heads of garlic into their subterraneous walks. It is likewise employed with success against grubs and snails.

New Preparation of Vinegar.

Take a cask made of oak, of a size proportioned to the quantity of vinegar required; this cask must have a bung about an inch and a half from the bottom, for the purpose of drawing off the liquor, but it must be set on one end to perform the operation. Rain or river water only can be used for this preparation; a quantity of either must be put into the cask equal to the quantity of vinegar required.

To thirteen quarts of water add half a pint of brandy, four ounces of tartar of wine, 12 ounces of sugar, and six of yeast. Reduce the tartar and sugar to powder, dissolve it in warm rain-water, adding the yeast, so as to form

form a thick solution, which, being mixed with the brandy, must be poured into the cask, and the latter must be placed in a warm situation for about six weeks.

Before the cask is bunged up, the water, and other ingredients contained in it, should be shaken together, to mix them as much as possible. Half an hour is sufficient to render the mixture complete, after which it must be left in repose for the time specified. This vinegar, when drawn off into bottles and well corked, will keep a long time, and is not inferior to any vinegar hitherto known.

New Substitute for Coffee.

M. Dieudonné has discovered a substitute for coffee, in a substance which has hitherto been thrown away in great quantities, as of no use: this is the seed of gooseberries, after the expression of the juice; these are washed and dried, and afterwards roasted. When they come to be ground they have almost the exact smell of coffee, and are excellent when taken in the same way. Some of these seeds, kept six weeks by M. Dieudonné, still retained the smell of coffee. By mixing them with an equal part of real coffee, a liquor is produced, the taste of which does not differ at all from that of ordinary coffee.

Discovery of a new Species of Wheat.

M. de la Haye has announced that he discovered, during his travels, a species of wheat, a single grain of which in good earth produces a trunk with twelve to eighteen shoots. Each branch or shoot has a bunch, composed of ten or twelve ears, each ear containing from ten to twelve grains. M. de la Haye has made the Minister of the Interior acquainted with this discovery, and great advantage is expected to be derived from its cultivation.

Method of purifying corrupted Water.

M. Deyeux lately made, at the School of Medicine, a public experiment on his filtres for clarifying and purifying water. A vessel was brought him containing water taken out of the kennel, and another filled from a tub in which carcases had been immersed upwards of three weeks. Having poured them upon his filtres, the water ran off in a few minutes perfectly clear, limpid, without taste or smell, equally bright and inviting as if it had distilled from the rocks.

The filtre used by M. Deyeux was only a large tin funnel, containing at the bottom a few pieces of glass, intended merely to support and prevent the pipe of the funnel from being choked by the small pieces of charcoal with which it was about two thirds filled. The charcoal was broken into small pieces of about two lines, or five cubic millimetres; it might even be broken still smaller, provided it was not reduced to powder, which might easily be prevented by passing it through a sieve. The other third part of the funnel was intended for the reception of the water.

List of Patents for Inventions, &c.

(Continued from Page 400.)

THOMAS ROWNTREE, of Great Surry-road, in the parish of Christ Church, in the county of Surry, Engine-maker; for a machine on an improved construction, for agitating and separating certain mixtures.
Dated March 23, 1804.

END OF THE FOURTH VOLUME, SECOND SERIES.

INDEX

TO THE

FOURTH VOLUME, SECOND SERIES.

A — Page

AGRICULTURE, comparative experiments in, - 358
Air-balloons, on their use in the military science, - 57
Alkohol, method of converting into ether almost the whole of any quantity of that liquid, - - 283
Ambuscade, a frigate, sunk near the Nore, method of recovering her, - - - - - 427
Ammoniac, liquid, improved method of preparing it, 74
Arts, Manufactures, &c. intelligence relating to, 76. 150. 236. 307. 396. 461

B

Barilla and Kelp, patent for preparing them, and the neutral salts obtained from them, - - 1
Bell, Miss. Patent for a method of sweeping chimneys, and manner of constructing them, - - 174
Bennet, Mr. Patent for a method of felting woollen cloth, 403
Bevans, Mr. Patent for machinery for striking or sticking mouldings, - - - - 171
Boond, Mr. Patent for a new manufacture of mixed and coloured cotton velvets, - - 252
Boswell, Mr. On the advantages of his patent method of constructing ships, - - - - - 430
Bouillon la Grange, M. New process for preparing the muriates of barytes and strontian, - - 439
Bramley, R. R. Esq. Observations on the dry-rot in timber, and means of curing or preventing it, - 353
Bridge, account of one constructing at Paris, - - 456

C

Page

Cables, patent for making them, - - 81
Calamines, chemical analysis of some, - 254
Cards, for carding Wool, patent for a machine for making them, - - - - 331
Carriages, patent for applying steam-engines to driving them, - - - - 241
Cattle, hints regarding them, - - 36
——— appendix to hints regarding them, - - 110
Chay-root, observations on its use in dying a durable red, 423
Chimneys, on the means of abolishing the horrid practice of sweeping them by children, - - 51
——— patent for a machine for sweeping them, 90
——— patent for a method of sweeping, and manner of constructing them, - - - 174
——— method of constructing or altering them to prevent their smoking, - - - 371
Cloth, patent for manufacturing it, - - 340
——— patent for a method of felting it, - - 403
Cobalt, method of obtaining pure metallic, - 126
——— on the preparation of a blue colour from it, 449
Copper, on the art of hardening it, - - 234
Cordage, patent for making it, - - - 81
Cotton-yarn, method of dying it a fixed Turkey red, 105
——— *velvets*, patent for a new manufacture of, - 252
Craanen, Mr. Patent for making verdigris, - 9
Curaudau, M. On the causes of the imperfection of furnaces for evaporation, - - - 383
Curwen, J. C. Esq. Experiments on feeding cattle with potatoes, - - - - 417

D

Davis, Mr. Patent for a machine for sweeping chimneys, 90
Delarue, A. G. M. Suriray. Method of producing fruit from trees inclined to run to wood, - - 285
Derrick, patent for one, for loading and unloading ships, 93

Deschamps,

Page

Deschamps, M. Process for extracting the salt with a calcareous basis contained in yellow quinquina, - - 391

Dry-rot, observations on, and means of curing or preventing it, - - - - - 347

Duhamel, M. Memoir on the refining of lead, - 194

Dundonald, Earl of. Patent for new methods of preparing hemp and flax, - - - - 344

E

Earthen-ware, method of rendering it capable of resisting sudden transitions from heat to cold, - - 141. 211

Everett, Mr. Patent for Salisbury angola moleskin, 249

F

Fairman, William, Esq. Experiments on extreme branch-grafting, - - - - 98

Fermentation, vinous, memoir on, - - 67. 130

Fires, description of an apparatus for extinguishing those which may happen in cotton factories, - 281

Fleming, Mr. Observations on the chay root used for dying red, - - - - - - 423

Fluids, remarks on the resistance of them, - 121

Fluxes, patent for some, for purifying mineral and metallic bodies, - - - - 250

Fourmy, M. Method of making earthen-ware capable of resisting sudden transitions from heat to cold, 141. 211

Fruit-trees, method of producing fruit from such as are inclined to run to wood, - - - 283

Furnaces for Evaporation, on the causes of their imperfection, and new method of constructing them, - 383

G

Gallic Acid, pure, on the preparation of it, - 388

Gilding metals, notice on several processes for, - 298

Gold, on the various alloys, specific gravity, and wear of it, - - - - 12

Page

Gould, Mr. Patent for an hydrometer, - - - 10
Grafting, extreme branch, experiments on, - 98
Gun-lock, description of an improved one to prevent accidents, - - - - - 346

H

Harbours, patent for machinery for cleansing them, - 161
Hatchett, Charles, Esq. Experiments and observations on the various alloys, specific gravity, and wear of gold, 12
Hately, Mr. Patent for fluxes for purifying mineral and metallic bodies, - - - - - 250
Haussman, M. Process for obtaining Turkey or Adrianople red, - - - - - - 452
Hawkins, Mr. Patent for machinery, and methods for writing, - - - - - - 327
Hemp and Flax, patent for new methods of preparing them, 344
Herrings, notice on the Dutch method of salting them, 305
Holmes, Rev. Mr. On meteorology as applicable to husbandry, - - - - - 271
Hooper, Mr. Patent for machinery for cleansing harbours, 161
Huddart, Mr. Patent for making great cables and other cordage, - - - - - - 81
Hydrometer, patent for one, - - - 10
Hymans, Mr. Patent for a composition for shaving without razor, soap, or water, - - - 405

J

Johnson, B. Observations on the dry-rot in timber, and means of curing or preventing it, - - 348

K

Kentish, Mr. Patent for an improved derrick for loading and unloading ships, - - - 93
——— Observations on his patent, - 94
Kermes, mineral, improved method of making it, - 140
Knapping,

Page

Knapping, Mr. John. Method of gaining land from the sea, - - - - - - - 412
Knight, T. A. Esq. Experiments on the descent of sap in trees, - . - - - - 182

L

Land, method of gaining it from the sea, - - 412
Lead, memoir on the refining of it, - - 194
Lomet, A. F. On the use of aërostatic machines in the military science, - - - 57
Loosemore, Mr. Patent for manufacturing cloth, - 340

M

Medhurst, Mr. Patent for a condensing wind-engine, 406
Metals, processes for gilding and silvering them, - 298
Meteorology, on its application to husbandry, - 271
Mineral and metallic Bodies, patent for fluxes for purifying them, - - - - - - 250
Minerals, process for extracting soda from them, - 295
Mouldings, patent for machinery for striking or sticking them, - - - - - 171
Muriates of Barytes and Strontian, new process for preparing them, - - - - - 439

N

Narci, P. Torelli di. On the double refraction of rock-crystal, - - - - - 367
Neukstead, Mr. Patent for preparing barilla and kelp, and the neutral salts obtained from them, - 1
Norton, Mr. John. Description of an improvement on the siphon, - - - - - 366

O

Orchis Root, on its preparation, culture, and use, - 274

P *Papillon,*

P

Page

Papillon, M. J. P. Method of dying cotton-yarn a fixed Turkey red, - - - - 105

Patents, monthly list of, - 80. 160 240. 320. 400. 464

Percival, Dr. On the preparation, culture, and use of the orchis root, - - - 274

Piault, M. Method of constructing or altering the flues of chimnies to prevent their smoking, - - 371

Plough-shares, cast-iron, patent for making and tempering them, - - - - - 97

Potatoes, experiments on feeding cattle with them, . 417

Prussiate of potash, on the preparation of one perfectly free from iron, - - - - 374

Prussic acid, on the nature of its combinations with salifiable bases, - - - 377

Q

Quinquina, extract from a memoir on the febrifuge principle of it, - - - - - 127

——— process for extracting the salt with a calcareous basis contained in it, - - - 391

R

Ransome, Mr. Patent for making and tempering cast-iron plough-shares, - - - 97

Richter, J. On the preparation of a prussiate of potash perfectly free from iron, - - - 374

——— On the preparation of pure gallic acid, 388

Roberts and Cathery, Messrs. Patent for eradicating the smut from wheat, - - - - 181

Rock-crystal, on its double refraction, - - 367

S

Salisbury angola Moleskin, patent for, - - 249

Sap, experiments on its descent in trees, - - 182

Schmidt,

Page

Schmidt, M. Description of Woulf's apparatus, with moveable conducting tubes, - - 373
Sea, method of gaining land from it, - - 422
Seguin, M. Extract from a memoir on the febrifuge principle of quinquina, - - - 127
Sharp and Whittemore, Messrs. Patent for a machine for making cards to card wool, - - 381
Shaving, patent for a composition by which that operation is performed without razor, soap, or water, - 405
Ships, patent for a method of strengthening them, - 6
—— patent for a derrick for loading and unloading them, 93
—— on the advantages of Mr. Boswell's patent method of constructing them, - - - 430
Sinclair, Sir John, Bart. Hints regarding cattle, - 36
—————— Appendix to hints, - 110
Siphon, description of an improvement on the, - 366
Smithson, J. Esq. Chemical analysis of some calamines, 254
Smut in Wheat, patent for eradicating it, - - 181
Soda, process for extracting it from minerals, - 295
Spectacles, patent for an improvement in them, - 401
Steam-engines, patent for improvements on them, and for applying them to driving carriages, - 241
Stuard, Mr. Patent for a method of strengthening ships, 6
———— Observations on his patent, - 8

T

Thenard, M. Memoir on vinous fermentation, 67. 130
———— On the preparation of a blue colour from cobalt, - - - - 449
Thermometer, description of a portable one, - 228
Trees, experiments on the descent of sap in them, 182
Trevithick and Vivian, Messrs. Patent for improvements on steam-engines, - - - 241
Trommsdorff, M. Method of obtaining pure metal ic cobalt, 126
Turkey Red, process for obtaining it, in its greatest beauty, 452